SCIENCE TODAY AND TOMORROW

Teachers' Edition

Science Near You

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Science Near You

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Ginn and Company

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SCIENCE TODAY AND TOMORROW

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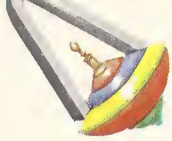

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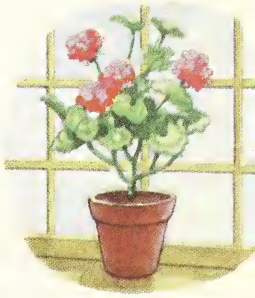


Water

Water is in the clothes.
The clothes will get dry.

Now the clothes are dry.
Where did the water go ?

The red paint is dry.
It needs water.

Now the paint is wet.
Where will the water go ?

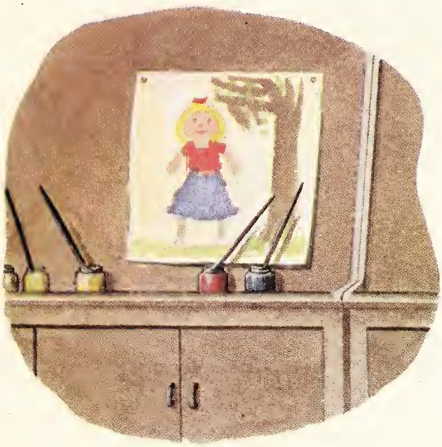
The dog will get wet.

Now the dog will get dry.
Some water will go into the air.

You Can Do This

Where did the water go?

Where Will the Water Go?



Wet clothes can dry.
Wet paint can dry.
Many things can dry.
Water can go into the air.

Animal Homes

This animal makes a home in a tree.

These animals make a home, too.

You may see these animals.
How do they make homes ?

You may see these animals too.
How do they make their homes?
You can look for animal homes.

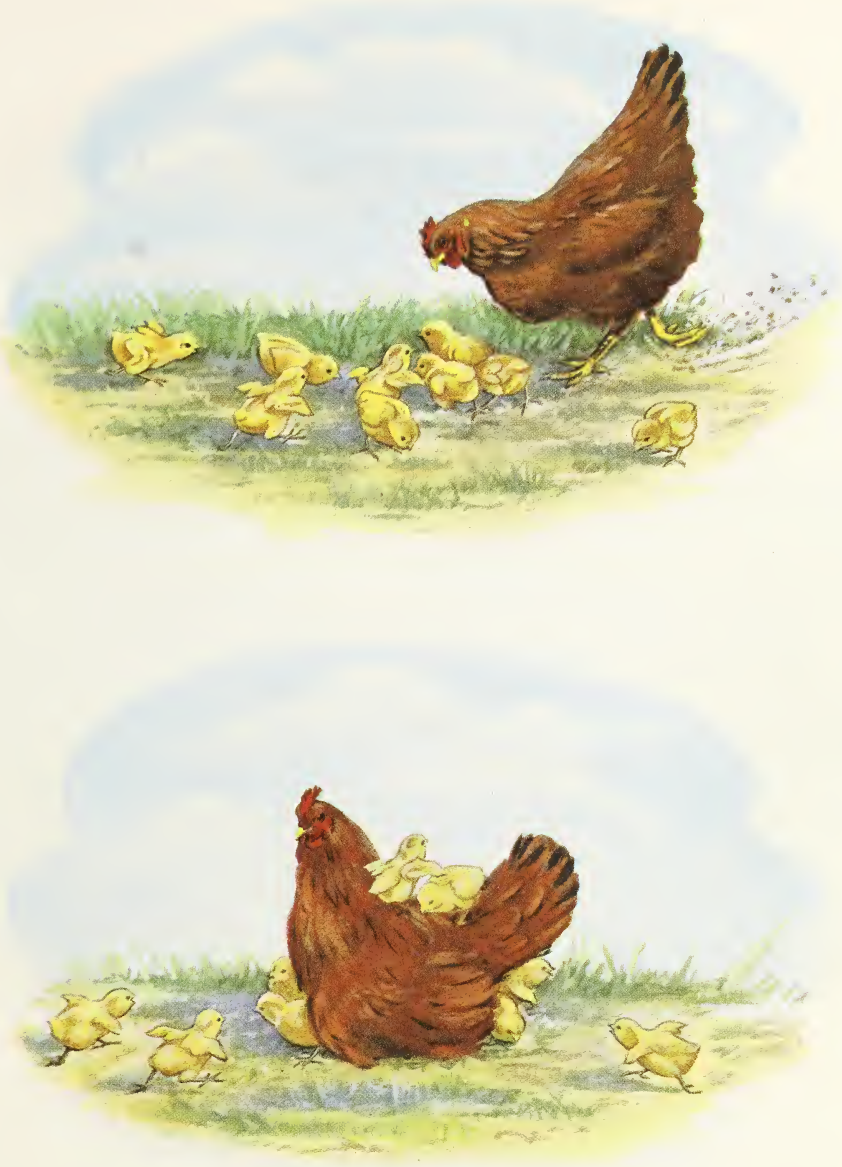
These animals make their homes.
Where have you seen homes like these ?

Which Animals May Have Homes Here?

Some animals make homes.
Where have you seen animal homes?

Young Animals

The young animals need care.
The mothers care for their young.

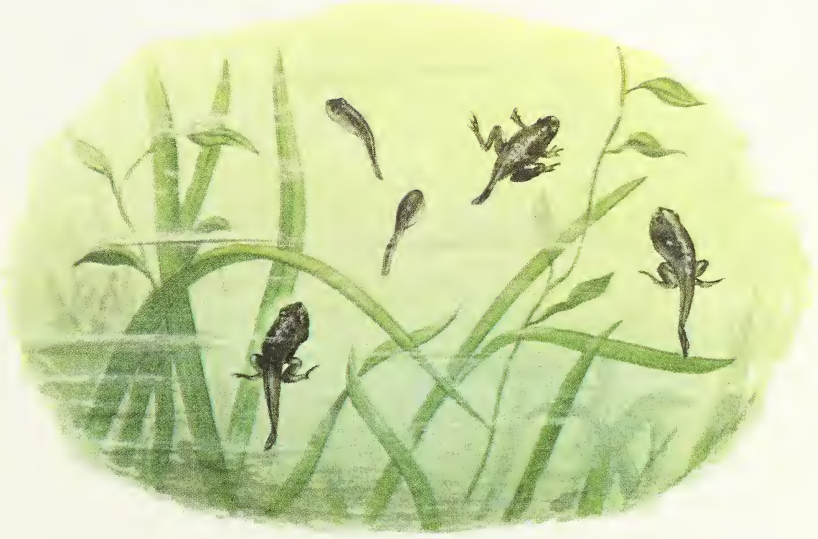


Where have you seen these young animals ?
How did the mother care for them ?

Do you have kittens ?
How does the mother care for them ?

The young ducks need care.
The mothers care for them.

These young animals need care, too.
How does the mother care for them?



These are young animals.
There are no mothers here.
The young animals do not need care.

The mother of these animals is not here.
She does not take care of them.

These animals do not need their mothers.
Where have you seen animals like these ?

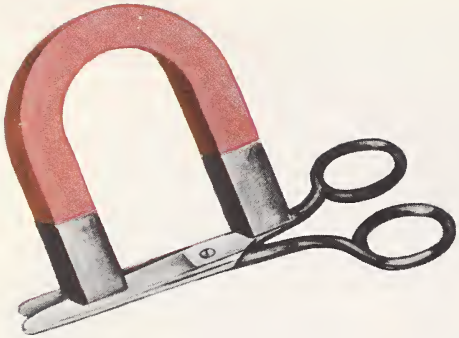
Which Young Animals Need Care?

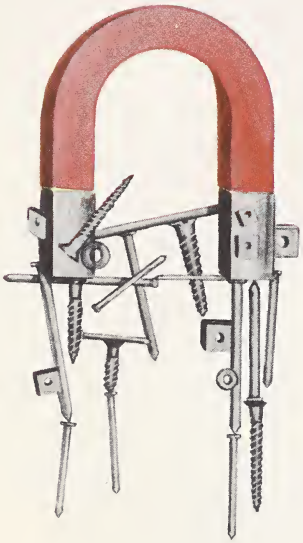
Some young animals need care.
Some young animals do not need care.

Magnets

John can work fast.
He has a magnet.
What can he do with the magnet?

What will your magnet attract ?





What does this magnet attract?
Magnets attract many things.
Will your magnet attract many things?

The magnet can not attract Betty's hat.

"Look," said Betty.
"Magnets do not attract these things."

" See what my magnet can do," laughed Betty.

" My magnet can do something, too," said David.

" My magnet can do this," said John.

" My magnet attracts the can.
It makes the can move," said David.

Magnets

Here are some magnets.

What Can Betty Do with Magnets?

Betty can do these experiments.
Show experiments you can do with magnets.

A Way to Go Up and Down

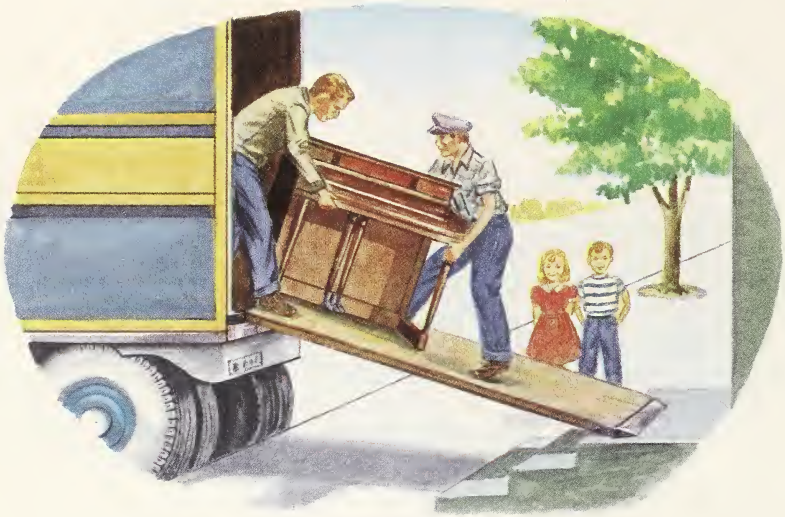
"This is a good way to go up.
It is an easy way," said David.

"This is too hard," said Ann.
"I know an easy way," said David.

David said, "This will help you.
Then your truck will go up.
It will go up an easy way."

" What fun," said Ann.
" See my truck go up."

" Now my truck runs up," said John.
" It will run down too.
This is an easy way."



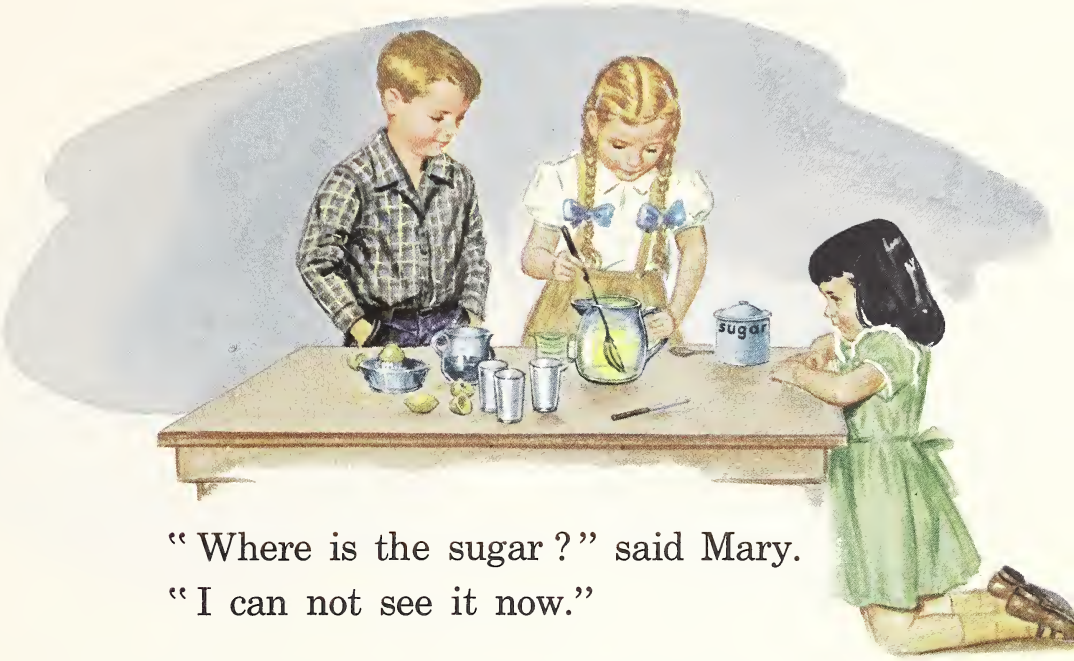
The men have a ramp.
Things can move down a ramp.

These men have a ramp, too.
Ramps make it easy to move things up.

Find Easy Ways to Go Up and Down

Ramps make it easy to go up and down.
They make it easy to move things up and down.
Where have you seen ramps ?

How Water Changes Things



"Where is the sugar?" said Mary.
"I can not see it now."

"The sugar is there," said Betty.
"It is in the lemonade."

"The lemonade is good," said Betty.
"The sugar went into the lemonade.
The sugar made the lemonade good."

"See, Mother," said David.
"The sugar is not there."

"It went into the water," said Mother.
"Sugar dissolves in water."

David said, "Look, Mother.
See the salt go into the water."

"Salt can dissolve, too," said Mother.

Experiments for You

Which things dissolve ?
Which thing does not dissolve ?
Some things dissolve in water.
Some things do not dissolve in water.

Air Around You

" Our boats go fast," said Mary.
" The air moves our boats," said Father.
" It makes the big boats move, too," said David.

Air is around David and Mary.
David can feel the air move.
Mary can feel the air move, too.

Betty's Experiment

" Is something in this glass ? " said Betty.
" No," said the children.
" Yes, there is," said Betty.

" There is air in the glass.
I will show you," said Betty.

" Look at the cork," said Betty.
" I will make the cork go down."

" Why did the cork go down ? " said David.
"Air is in the glass," said Betty.
" The air in the glass made the cork go down."

Experiments with Air

"Is air in this box?" said Mary.
"You can find out," said Miss Mills.
"David can show you."

"Air is in the box," said David.
"I can show you.
Look, I can make it go out."

" See my experiment," said Mary.
" Look at the bubbles," said Betty.
" There are many, many bubbles."
" They are air bubbles," said Miss Mills.

David said, " Now the water can go out."
" Yes, and the air can go in," said Mary.
" Look at the big air bubbles."

You can put air in some things.
Show what you can do.

How Do You Know Air Is Here?

Air can move some things.
You can see the things move.
You can feel air move.
You can put it in some things.
Air is around you.

The Sky

" See the sky change, " said David.
" Now some of the sky is blue."

" Mother, see the colors in the sky.
The colors change fast," said David.

Some clouds are in the sky.
The sun is in the sky, too.

Now there are no clouds.
The sun is in the blue sky.

The moon is in the sky.
The sun is there, too.

David can see the sky change.
He can see some clouds.
He can not see the moon.

Now it is night.
The sun is not in the sky.
What do you see in the sky at night?

Here it is night.
The moon is in the sky.
There are no clouds.
The night sky changes, too.

What Changes in the Sky Do You See Here?

What do you see in the sky?
Look for clouds.
Look for the moon.
What color is the sky?
The sky can change fast.
What changes do you see?

Rocks Near You

Here are many, many rocks.
Some of the rocks are big.
Some of the rocks are little.

"I have a soft rock," said Ann.
"Look, I can break it.
I can break it into little rocks.
You can break the soft rock, too."

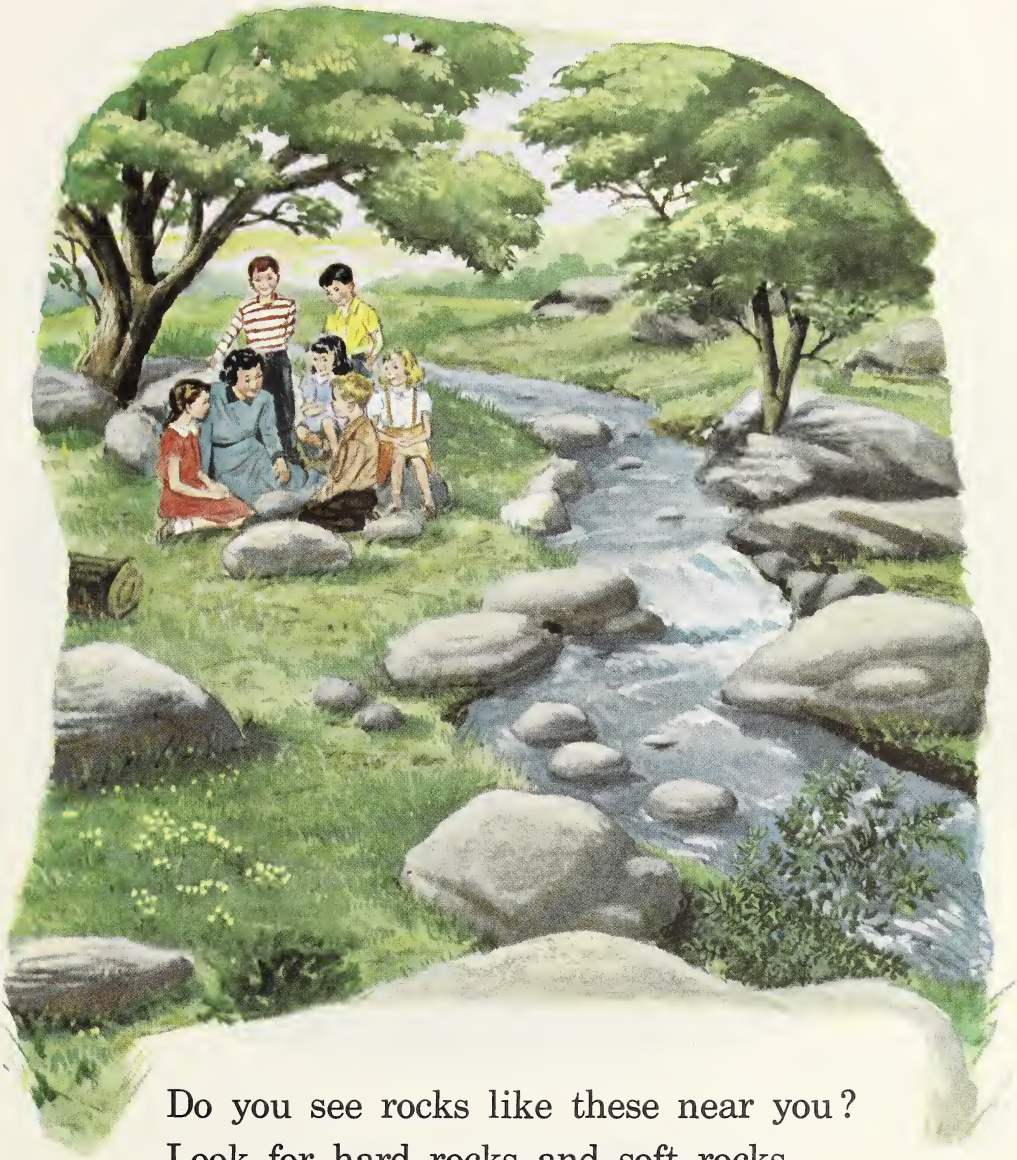
"I can not break these rocks.
They are not soft," said Ann.
"They are hard, hard rocks."

"This rock feels rough," said David.
"This rock feels rough, too," said John.
"Many rocks are rough."

"Look at this rock," said John.
"It feels smooth."

"I know why the rocks are smooth," said David.
"Water and little rocks made them smooth."

What Kinds of Rocks Are Here?



Do you see rocks like these near you?
Look for hard rocks and soft rocks.
How do you know which rocks are hard?
Look for rough rocks and smooth rocks.
Why are some rocks smooth?

Land Near You

John lives here.
David lives here.
Ann will live here, too.
She will have a new house.

This is John's home.
John can see big rocks.

John can see a big shovel.
The shovel can move big rocks.
Ann will live here.
She will have a new house.

John can see the land far away.
He can see the river too.
David's house is near the river.
It looks far, far away.

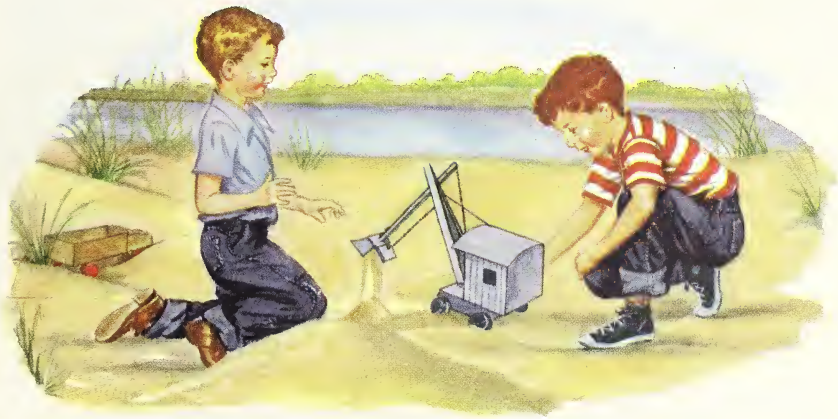
John walks down the big hill.
He wants to see David.
It is easy to go down the hill.

David lives here.
He lives near the river.

"This is my new shovel," said John.
"We can play in the sand."

"Now we can go," said Mother.
"Take your shovel, John."

David and John can play near the water.
They can make things in the sand.



David and John will make big hills.
They will make a river in the sand, too.

"Look," said John.
"I made some big hills.
It is fun to go up and down the hills."

"I made a river," said David.
"Now I will make my house near the river.
I like to make things in the sand."

John and David's Map

John and David work on their map.
The children help them.
Miss Mills helps them, too.

Find the hills on the map.
Find the river on the map.

You can make a map, too.
You can make a map of where you live.

The Land Up and Down

Some children walk up the hill.
Some children ride up the hill.
It is hard to go up the hill.

The children go down the hill.
It is easy to go down the hill.

How Does the Land Look Near You?

In some places there are many hills.
In some places there are no hills.
In some places there is water.
And in some places there are many rocks.

Plants in Many Places

"I see many kinds of plants.
I see plants far away," said Mary.

"Some of them are big.
And some of them are little," said Ann.

"The trees are big plants," said Father.

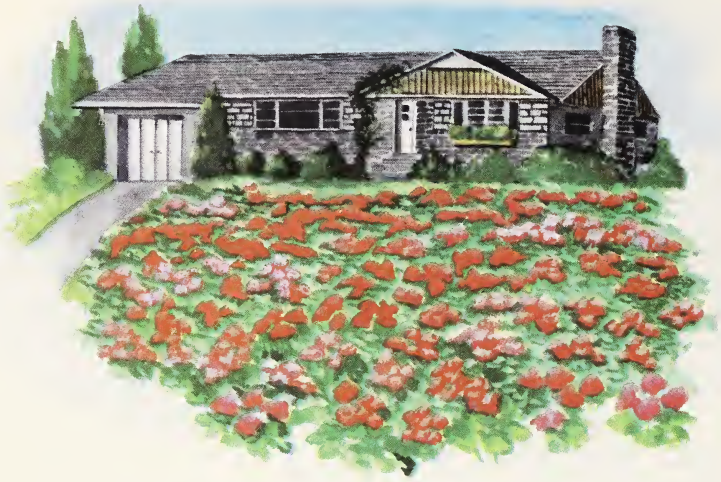
The children see many plants here too.
Where do you see plants grow ?

" These are little plants," said Ann.
" Many of them grow here."

Ann has some flowers.
Mother has some flowers, too.

Look for plants around your home.
Some of the plants may have flowers.

There are many kinds of plants.
They grow in many places.

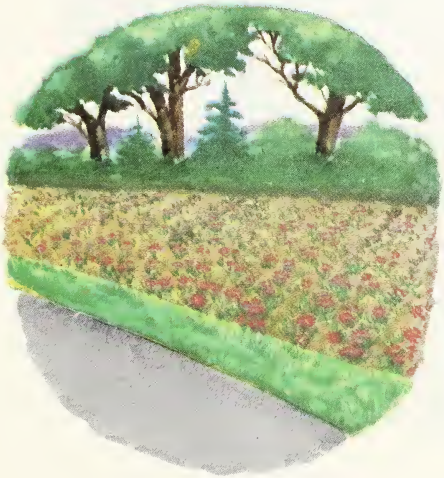


These plants grow near the house.
They have flowers, too.
Many kinds of plants have flowers.

Many plants grow here.
Some of these plants have flowers.

Where Do Plants Grow Near You?

Plants grow in these places.



Plants grow here too.
Plants grow in many places.

How Plants Grow

These plants grow out of seeds.
The plants grow and grow.
The children take care of the plants.

Experiments with Plants

Ann wants to see some seeds grow.
The seeds need water and sunlight.

Ann's plants grow out of seeds.
The seeds have food for the plants.

You can do this experiment, too.

This is part of a plant.
This part of a plant has food.
It can grow.
It needs water and sunlight to grow.

This is part of a plant.
This part of a plant can grow, too.
Why does it grow?

The plants need the sunlight.
They are green in the sunlight.

Now the grass is yellow.
It did not have sunlight.

What Do Plants Need?

Here are many plants.
The soil has food for the plants.
The plants need food to grow.
They need water and sunlight too.

How Do These Plants Change?

These plants change and change.
They grow big and have flowers.
They grow big and have seeds too.
What changes in plants have you seen?

The Soil

The water runs fast.
The water runs down the hill.
It will wash soil down the hill.

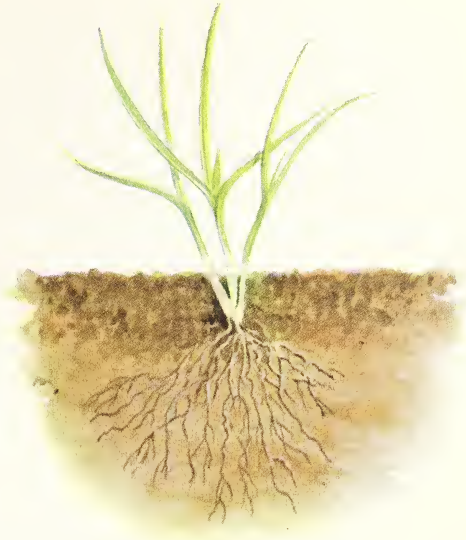
"The rocks will hold the soil," said John.
"The soil will not wash away."

"This grass seed will grow fast," said Ann.
"Grass will hold the soil, too."

"The rocks hold the soil," said John.
"The grass holds it, too," said Ann.
"Now our soil can not wash away."
"We need our soil," said Miss Mills.

Grass Plants Hold Soil

A grass plant
looks like this.



It looks like this
in the soil.

Many grass plants
look like this.

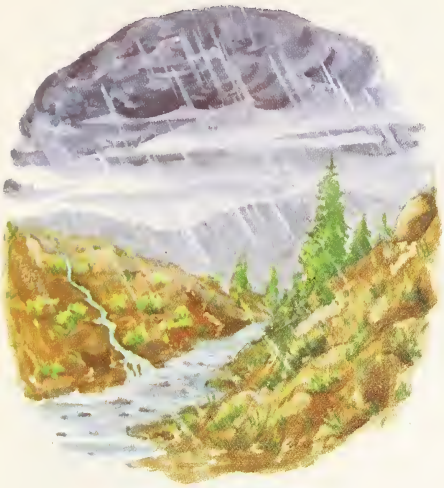
They look like this
in the soil.

Grass plants hold soil.
Do you know why?

Blow, blow, blow.
The wind blows the soil.
The wind blows the soil around.

The men put many plants in the soil.
The plants will hold the soil.
Then the wind can not blow the soil.
And the water can not wash it away.

What Holds Soil Near Your Home?



Look for places like these.

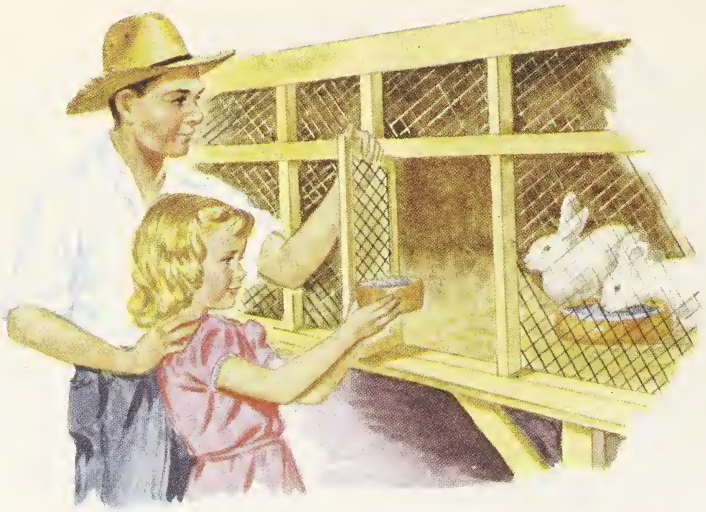
Plants and rocks hold soil.
Then wind can not blow the soil.
And water can not wash it away.

Animals and Plants

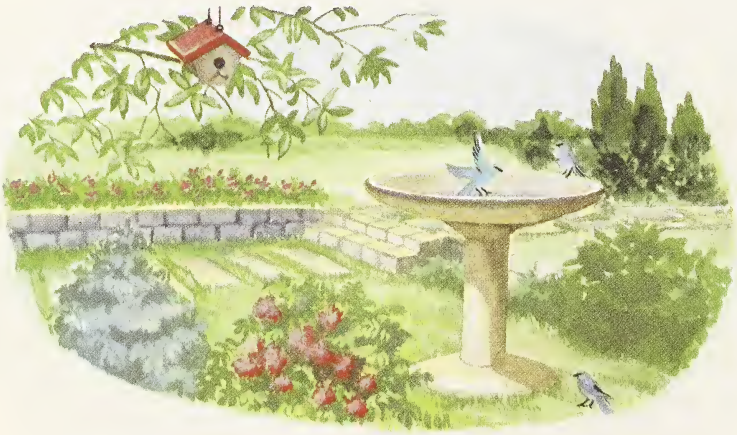
David and Patsy went for the cows.
Now Father will care for the cows.

The cows need food and water.
Father cares for the cows in many ways.

David cares for Patsy.
He cares for Patsy in many ways.
Do you have a dog?
How do you help care for your dog?



These animals have a good home.
Ann helps care for them.
How do you help care for animals?



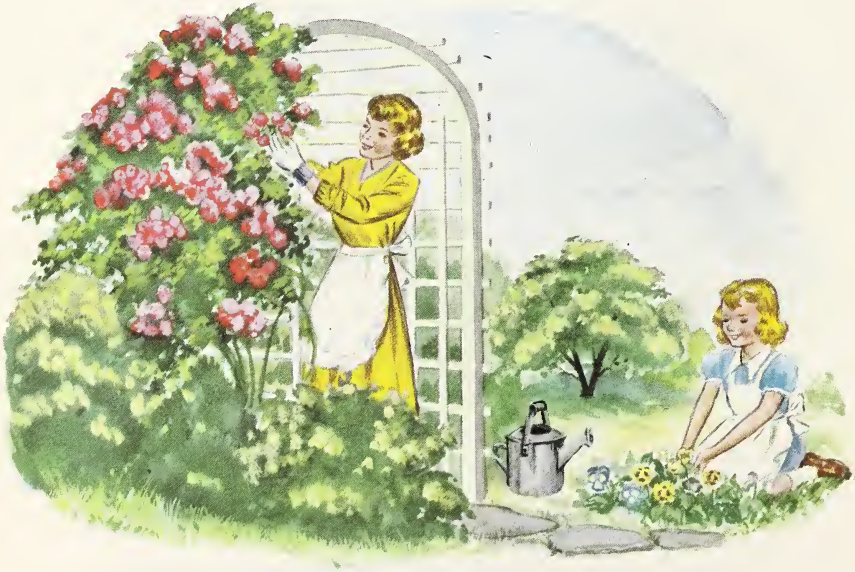
You can help some animals.
Put out water for them.
Put out some food for them, too.
Make a house for some of them.

People help animals here too.
People grow many plants.
Some animals can find homes here.

Some people make a pond for animals.
Many plants grow around the pond.
Then some animals go there to live.
Some of them live around the pond.
Some of them live in the pond.

Care of Plants

How does Ann care for the plant ?



Ann and Mother care for the plants.
How do you help care for plants ?

These trees need water.
They need good care.

The men know what these trees need.
They take good care of the trees.
Men care for trees in many ways.

Many plants grow on these hills.
The plants have many flowers.
These people do not take them.
They want them to grow and grow.

How Do People Care for These Animals and Plants?

People need to care for animals.
People need to care for plants too.
How do you care for animals and plants?

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TEACHERS' MANUAL

for Science Near You

SCIENCE TODAY AND TOMORROW

Gerald S. Craig
Bernice C. Bryan

Ginn and Company

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Foreword

Science Today and Tomorrow

During the last twenty-five years, science has grown steadily in the elementary schools of the United States, Canada, and various countries of Europe, Asia, and Africa. This is no ordinary event, for new areas are not easily established in the elementary school, owing to the tremendous pressure of various groups to gain the attention of children.

Science in the elementary school has to a large extent been developed by classroom teachers. They have experimented with new activities, new content, and new methods. Many of them have constructed curriculum materials and developed reading materials in science for the elementary school. As a result of this work, instruction in science in the elementary school is uniquely designed for use by classroom teachers.

The new elementary-school program with its emphasis on science is a feasible program because it recognizes that the classroom teacher has many professional tasks; teaching science is but one of them. The teacher is a specialist in the education of children and not necessarily a specialist in science. There is no need for classroom teachers to feel any responsibility for specialized science tasks, such as naming all the objects in the environment, animate or inanimate, or serving as a field naturalist, a laboratory technician, or a general bureau of information.

It is evident that only those subjects that are in keeping with the basic purposes of the elementary school succeed in maintaining a permanent place in its curriculum. The American elementary school is a unique institution. It has been called at times "the great common school," in that it is the school for all the people. It was established by the early forefathers as the one institution that would be common to everyone, regardless of race, religion, economic status, and future occupation. It has become the basic institution dedicated to the task of the education of all people for citizenship in a democracy. A significant part of the success that science has had can be accounted for by the fact that elementary-school workers have been concerned that science be developed in the interests of *all* boys and girls. This pattern for science in public elementary education is being adopted by a number of democratic countries.

Science from the Developmental Point of View

Science in the education of children should be considered wholly from a developmental point of view. Recognition will then be given to the fact that children do not come to school for the first time at zero in science learning.

They have had a wide range of rich experience with physical and bio-

logical phenomena. They may have had a variety of experiences including those with friction, momentum, inertia, magnetism, static electricity, simple electric circuits, snow, ice, water, steam, melting, boiling, freezing, conditions necessary to certain living things, care of animals, seasonal change, the sun, the moon, stars, clouds, mirrors, magnifying glasses, evaporation, condensation, varieties of kinds of locomotion found in the animal world, animal mouths, ears, noses, coverings, balance with building blocks, wagons and tricycles, heat and cold, effects of seasonal change, different animal habitats in the community, solution of solids in liquids, molds, the large number of seeds produced by some plants, and so on. They may bring with them misconceptions and superstitions, or they may come to school with a good attitude, conducive to learning and the development of intelligent and resourceful behavior.

Many teachers of children find it useful to accept a point of view of dynamic psychology for understanding children. Their ideas may be stated simply in such words as these: A child lives in a dynamic universe which is new to him. He is challenged by his many experiences. This universe is filled with a great variety of objects. He is impressed by the events (phenomena) small and large occurring about him, such as rusting, rain, weathering rocks, electrical shocks, thunder, wind, and falling objects. He finds himself in normal circumstances tremendously stimulated and turns naturally to exploring and learning.

A young child is naturally egocentric. He is not to be condemned for being so; his egocentricity grows out of his great potentialities for ceaseless drive and for adjustment and understanding of his environment and himself. As a result of the great drives and yearnings, he feels inside himself a whole gamut of emotions which are to him discoveries about himself. He may display grief, irritability, anger, restlessness, impatience, and disappointment. Although such expressions are not to be condoned or encouraged in children, they are not to be considered in themselves evil, for out of these emotional drives have come many of the great constructive developments of mankind, such as democracy, better living conditions, religious freedom, and improved health.

A child is an energy system, and in all the universe we do not find its equal. It is remarkable that out of the use of his energy, a child is becoming intelligent in a universe filled with a vast variety of living and nonliving objects, an almost kaleidoscopic array of events and changes. Within his rapidly widening universe, the child attempts to identify himself and his inheritance. Viewing children from this dynamic point of view assists parents and teachers to understand that the drives of children, which are so frequently annoying to the adult, are potentially constructive traits.

A child learns about his environment whether he is taught science or not, although some of his learning may be negative in value. The kind of science learning considered in this Manual begins in the cradle. As a child begins to separate himself from his environment he begins to develop learnings based on these experiences. Parents and teacher must recognize that there may be learning about the environment even though a child is unable to state meanings in words. For instance, a child is experiencing something with the rattle he places in his mouth although he has no words with which to shape thought. He is learning something about the earth and its gravity as he pushes his weight against it in taking his first steps. Were the earth like a suspended rubber balloon that bounced away from him, or if the gravity were not constant and pulled him with greater force at some times than at others, he would develop a different set of attitudes and behavior. In considering science in the program of elementary education, it is well to conceive of science experiences as beginning with birth. In a real sense, the adjustment to the environment can be traced back to the prenatal stages.

In a very real sense, we might say that the potentialities of science are inside human beings. To make it more personal we may think of these potentialities as being in such human beings as ourselves—teachers and children in the classroom. This is true because science has grown out of a tremendous urge on the part of mankind through the long centuries to come to an understanding of the universe.

Man, from the remote past, has sought explanations for the things that happen in the world about him. The rainbow, birth, death, life, lightning, and other events challenged him. He frequently used great ingenuity and much fancy to develop explanations for the phenomena about him. The myths and legends of many peoples indicate men have felt that if they could understand the world about them they might know more about themselves, their origins and history. The fact that primitive people frequently associated their explanations with their religious beliefs demonstrates how important such explanations were to them. In fact, these explanations had much to do with man's adjustment to the environment. Sometimes man's explanations made him fearful and superstitious; at other times they filled him with confidence, calm, and resourcefulness.

According to the developmental point of view, the origin of science is in man's distant past. An implication of this for teachers in the elementary school is that science need not be thought of as something foreign to them or to the children they teach. Science as we know it today, with its discoveries and inventions, is the result of urges in men and women through the ages. We can see these same urges in children as

they follow their natural drives and as they attempt to secure adjustment and equilibrium in a dynamic universe. They use the senses of smelling, tasting, feeling, seeing, and hearing, the kinesthetic sense, imagination, curiosity, energy, irritability, restlessness, play response to external conditions, and other partly understood drives deep within their natures to project themselves into the areas of the environment. They depend upon impulse, fancy, creative activities, and logical thinking just as their ancestors did.

From the developmental point of view not all of science is difficult. On the contrary, from this point of view science is part of the earliest learnings of children. Furthermore, the technical, vocational, and specialized aspects of science have no function in elementary education. Elementary science is closely related to the experiences of children and to the kind of thinking they can do, so that teachers need have no fear of science. The teacher can learn the science that is needed while teaching science at any level in the elementary school.

The fear of science felt by some adults is not usually found in children. The adult may have been conditioned to a dislike of science in part by previous contacts with science instruction at high school and college levels, whereas children, having felt no such conditioning, are still following their natural impulses. Teachers can free themselves from their negative reactions if they will attempt to see the environment and science through the eyes of children. Encouraging children in a classroom to express themselves freely about their ideas of natural events has assisted many teachers to understand children and at the same time to gain a new look at the world for themselves.

Using Science in a Democracy

There has grown up a conviction that the free nations must remain strong if they are to remain free. There is also a realization that there is power in science, and therefore that science is an essential element in maintaining and improving the democratic way of life. It will not be enough to have a small portion of the population educated as scientists; to be truly strong, an entire nation must be conversant with science. To realize this goal, science must be placed in the curriculum as one of the fundamentals. Making a whole nation conversant with science is a task uniquely suited to the elementary school, since this is the institution of all the people. It is the institution which has in its enrollment not only the future scientists but laymen as well (everyone is a layman outside his special field).

Strength for free peoples is secured through the development of good

living conditions as well as military defense. Through the use of science man can do much to shape his own future, since science has tremendous potentialities for the improvement of living conditions for all.

The children now in the elementary schools will live in a world of tomorrow. Our boys and girls will live in a time of great decisions. They will need to make certain that science will be used for good and not for evil. They will need to determine how democracies can be kept secure. There will be great problems concerning the use of new and old sources of energy. Theirs will be the problems of wise utilization of natural resources, the distribution of new synthetics, medicines, and drugs, provision for health and well-being, development of materials from new sources, establishment and maintenance of research agencies dedicated to public welfare, the establishment of a balance of nature that will provide ample food and recreation for all, and the creation of a stable economy based on the natural resources and other problems to be solved, all within a democratic framework. Through all of this there will probably be a consideration of problems of international and world co-operation.

As we seek to determine what shall be the basis for our instruction in science in the education of children we find we must look to something more permanent than a mere teaching about objects. We make this decision because in a few decades we ourselves have witnessed a vast array of new inventions displace objects which once seemed permanent. Kerosene lamps have given way to electric lights in many places. We have observed the transition from telegraph to television. Our familiar world is in constant transition. So, although we may utilize objects in teaching children, we cannot base our curriculum on objects. We must look deeper for our basic purposes.

Some might say that our major purpose is giving children content. But the content of science, important as it is in the education of children, does not constitute the fundamental purpose of including science in the elementary curriculum. This is true, first, because our basic purpose must be in terms of children and society, and consistent with the dedication of the public elementary schools to the principles of democracy. Second, as we shall see later in this introduction, we must recognize that the content of science is not absolute; what we think is reliable information today may need revision tomorrow.

What we can be certain of is that boys and girls will need to be resourceful and democratic in the decades ahead if their and our way of life is to survive. Therefore, we are concerned with the development of resourceful and democratic behavior. If we succeed, we shall not need to be unduly concerned for the future, for with the development of

resourceful behavior in accordance with the high purposes of democracy, our boys and girls can use science to shape the future with complete confidence.

It is to be noted in this discussion that science is considered as a tool for humanity. There is no intent in the education of children to develop science for its own sake or to defend science as a vested interest. Only as science serves in the development of children and in the welfare of humanity can it be defended as essential in the education of elementary-school children.

It is most important that we recognize that boys and girls need to do much more than talk about science. If democracies are to preserve their way of life, there must be in their populations the ability to operate intelligently and resourcefully with the materials and energy of the universe to the best interest of mankind.

Social studies, however valuable they may be, are not sufficient in themselves to help children meet and solve the problems of today and tomorrow. Teachers and school systems are likely to miss the great contributions of science to children and through the children to the larger goals of democracy when they place science in the curriculum as a segment of the social studies. Science grows out of the tremendous urges of the human organism and does not have to be motivated through social studies. Many students of children think that science by its very nature is more challenging to young children than social studies. This is not to be interpreted as an argument against the social studies. It is, however, an appeal that curriculum workers thoroughly think through the concept that science is a part of the development of children. If properly guided, children can grow in intelligent and resourceful behavior just as they can grow physically if properly nourished.

Some have suggested that the primary purpose of science in the education of children is to develop "little scientists." Such an idea is not consistent with the fundamental purpose of the elementary school and the origin and nature of science in society. There should be no hero worship of scientists except in so far as an individual scientist deserves it. Democracy will be weakened if a society is created with a distinct scientific class. Scientists serve, but so do soldiers, senators, artists, carpenters, barbers, farmers, doctors, and everyone else. Scientists now and then outside their own special fields are somewhat naive, and at times exhibit traits of gullibility and dogmatism, thus violating the fundamentals of science. Scientists are human beings like other people. We should not set up the lives of scientists as ideals for children to follow, regardless of how much we may appreciate the contributions of science.

The Nature of Modern Science

In science we do not view knowledge as absolute. Any statement of science can be challenged, revised, or refuted with suitable data. There is no room for dogmatic attitudes. There can be no dictator for science.

Through science, man strives always for a better understanding of the world. Unfounded prejudices, opinions, gossip, rumor, astrology, myths, intuition, and superstition cannot be considered reliable sources.

Science is an active, dynamic field, constantly demanding willingness to make new observations, to repeat experiments, to consider new facts, and to challenge earlier conclusions. Science is far from a finished subject; in fact, it is likely that it is only in its beginnings. All the areas of science are undergoing changes as a result of continuous study. New ideas are being added and old ideas revised about stars, ventilation, living things, diseases, nutrition, and other areas of science.

Man learns through experiences by means of his senses. Science has produced new instruments, such as telescopes, microscopes, and others, that extend man's range of observation and experience. Nevertheless, to explain many happenings in nature, even everyday occurrences, is exceedingly difficult in spite of many new technical tools. So scientists have been forced to develop provisional explanations, or hypotheses, to guide them in further study of some things. But scientists must abandon any hypothesis as soon as it is found to be unsatisfactory. There is much that scientists have not satisfactorily explained. Many times a scientist must say he does not know even about problems within his own field of specialization, and even though he may by all rights be the world's leading authority on the problem involved.

Since man is continuously in the process of making new discoveries and revising his information, accuracy is not an exact status. This means that we do not teach a fact as though it must be true for all time. It indicates, also, that we cannot teach all the truth to a child about any single subject. We may, however, attempt to make certain in the classroom that the way in which a child learns is consistent with scientific attitudes.

We cannot hastily call an item correct or incorrect. Instead it is essential that in all our discussion, reading, experiments, and so on we determine what is the most reliable information at a given time. It may not be as serious a matter to be mistaken in the information we may have at any time, as to assume that there may be no need to secure new information on all important matters throughout our lives. It is also a serious matter to pass along information as if there were no question about its accuracy when we are not sure of its reliability. The nature of

modern science is thus entirely consistent with the idea that learning takes place through the continuous growth and development of large concepts. It also indicates how necessary it is to view education as a process which takes place from the cradle to the grave.

Accuracy is a direction toward which man in his best efforts strives. It is also a goal toward which teachers and children can move in teaching and learning; it calls for growth for both teachers and children. A child's ideas gained from science can be accurate in so far as they go, but as a child proceeds through the school his knowledge about any one subject increases in amount and detail. In other words, we may not be able to teach children all the reliable information in science about a given subject, but what we do teach can be consistent with what is reliable. Authoritative books such as those in the SCIENCE TODAY AND TOMORROW series can be most useful to both children and teachers in maintaining a high standard of accuracy and a sound development of attitudes.

Science and Behavior

This condensed description of the nature of science has been provided because it has many implications for the teacher and can provide him with a sense of security and adequacy in teaching children. The teacher has the right according to science to play an honest role in the classroom. He has a right to admit that he is learning; that he makes mistakes sometimes; that sometimes a child with a special interest and concentration may be learning faster than he is. In a real sense, the scientific method is a method of honesty, and neither teacher nor child should be penalized in any way for being honest. The learner should never be humiliated for the admission of ignorance. The implications of science for mental hygiene and human relations are profound.

It would be well for the teacher to consider the implications of science in the development of such behavior patterns as open-mindedness, critical-mindedness, and the avoidance of gullibility. There is no greater educational factor operating in the modern world than the attitudes that teachers and parents utilize while working and living with children.

In science it is important to state the source of one's comment in explaining a phenomenon, such as evaporation of water, hibernation of animals, erosion of soils, and so on. For instance, one might say, "I read an explanation in . . . ," or "It may be . . . ," or "My father said . . . ," or "On my way to school I saw . . . ," or "I think it might have been," or "I used my imagination," or "I think I am right," or "I can do an experiment to show . . ." This is preferable to giving such information as if the statements were unquestioned facts. We have

sometimes called this identifying the source of a comment. The teachers and children should develop the behavior pattern of identifying the source of a comment.

Both teachers and children have a right to use their imaginations, to speculate, to repeat information as long as they distinguish between reliable and unreliable information. Such a behavior pattern is in the direction of assuming responsibility for one's own speech. It is quite different from the behavior of gossip, loose talk, and rumor spreading.

This type of development should not be allowed to harm the good human relationships of children. Frequently children use parents' opinions as reliable information. It would be well for the teacher to handle such comments in a manner that will in no way decrease the child's respect for his parents. In a sense, the attitude of the teacher may be that we are glad to have what the parent has said, and indicate that further development of the statement is given in authoritative books. Perhaps the comment might be, "What do persons who spend their lives studying this kind of thing say?" Science instruction should be utilized to improve the human relationships of children, those of children with children, children with teachers, and children with parents.

It is obvious that the great behavior patterns growing out of science are not built in a finished manner in a day or a year or a decade. For instance, critical-mindedness and open-mindedness require time for development. Development of the patterns associated with resourceful, democratic behavior should be considered a continuous program throughout the elementary school.

There is considerable evidence that three great achievements of mankind—democracy, scientific method, and religious tolerance—developed contemporaneously and out of the same general struggles. An examination of these achievements will indicate that these three have much in common in basic meanings. In the opinion of many students, real science cannot exist outside a democracy.

The Content of Elementary Science

Almost everyone is impressed with the extensive nature of science; it has indeed grown tremendously in scope. No one can learn all of science in an entire lifetime. It is also obvious a teacher cannot teach it all. Only a very small portion of the total science will be taught to children, but that portion can be most important in the development of citizenship. The question of how much content of science is taught is not of nearly so great importance as is the question of what content of

science is taught and how it is taught. With the world situation as it is today, it is most important that the content and procedures of science suggested to teachers and children in such a series as SCIENCE TODAY AND TOMORROW be those designed for the preservation and advancement of democracy.

Because of the extensiveness of science, there has been a tendency to develop what might be called encyclopedic instruction. Under this method students have been required to learn wide areas of content. Comprehensive instruction has been developed about animate and inanimate objects and about topics in the environment, with little sensitivity on the part of curriculum makers as to the value of the content to the teacher and children involved. In the encyclopedic type of instruction the purposes of science in elementary education became lost in small content and busy work.

A traditional trend in nature study has been to make science instruction dependent upon an incident approach. If a child brings in an object, such as a rock, a feather, or a flower, or if he can relate an interesting experience, then there is instruction in this field about the object or incident. If there is no object or no incident, there is no science instruction in such classrooms. Science becomes incidental and accidental in the classrooms of teachers holding to this point of view.

But science is no incident in the lives of children. In fact, it is and probably will continue to be one of the most dominating and decisive factors in their entire lives. Schools developing science on an incidental basis will not provide boys and girls with the education they need for the great decisions they must make for themselves, their country, and the world.

This is not to say that incidents have no place in teaching-learning situations. Natural incidents can be used as experiences for concept-formation and for the development of understanding of phenomena. But science with its profound and challenging ideas has a great contribution to make to the formation of concepts and important ideas. If our democracy is to survive, we must make certain that the potentialities of science in our way of life will be developed. This instruction must not be incidental.

Since the best information scientists have at any one time will need to be revised in keeping with future discoveries, a content of science in the elementary school cannot be considered as set and fixed for even a few years. There are, however, certain patterns for the universe which seem to persist as profound descriptive principles for all time, in spite of revisions and modifications that follow new discoveries. These patterns are described in the following statements:

a. The universe is very large.
b. The earth is very old.
c. Many changes are going on in the universe.
d. Living things are interdependent and interrelated.
e. Living things which are living today are the results of adaptations that have been made in the past.
f. There is a great variety among living things.
g. There is evidence of a tendency toward balance among the forces and living things.

For the sake of brevity, we can speak of these patterns as principles of space, time, change, interrelationships, variety, adaptations, and balance.

These patterns seem to be guide lines for instruction through the elementary school. A child can continue to grow along the lines of these great principles or patterns. The experiences an individual has throughout life can enrich his understanding of these principles. Man must recognize these patterns if he is to adapt his civilization to this universe. A knowledge of these basic patterns is necessary to the understanding of the world's problems and life's experiences in our modern democratic world.

The Large Patterns of the Universe as Guide Lines for Teaching-Learning

The Universe Is Very Large—Space

As man has studied the universe that surrounds the earth he has become impressed by the immensity of space. The earth which he thought was very large and the center of everything is small compared with many other objects in the universe. This earth is one of several bodies which revolve about a star known as the sun. The sun is one of millions of stars which compose a vast galaxy of bodies called the Milky Way. Man has learned that there are many other galaxies within range of the modern telescope.

While a complete understanding of the immensity of space is undoubtedly beyond the mental capacities of any one individual, it can become a guiding factor in the interpretation of the experiences of children at all levels. The young child may begin his growth in the understanding of space as he begins to associate with himself the rooms in his home and the yard or immediate vicinity about his home. Later, he learns the location of the nursery school or kindergarten when he is taken there by adults or by school bus. Still later, he goes to school by himself and learns where the homes of his relatives and friends are in

relation to his own home. As he travels to neighboring communities his world becomes larger. He may be intrigued by the observation that the sun and moon seem to follow him as he moves about.

A child's early contact with this pattern may merely teach him that the earth is a very big place compared with his familiar neighborhood. He may become acquainted with the appearances of the day and night sky. Later, his learning will reveal that the earth is very small in comparison with the stars and space. About the same time he will also learn that the stars are suns which are very, very far away. In later years he increases his understanding of the vastness of space by learning about the extent of the solar systems, the Milky Way Galaxy, radio stars, cosmic rays, the galaxies, the light year, and so on.

Any adult who has read modern astronomy, has attended lectures in this field, visited an observatory or planetarium, or considered the possibilities of space travel knows that his conception of space continues to change after childhood. There are new, challenging thoughts for all levels—the junior high school, senior high school, and college levels—and, for that matter, many new discoveries still to be made by the astronomer. Some comprehension of this conception is essential to an appreciation of the significance of science in its revolutionary effect on modern thought. It is important that children should be started properly along this path rather than allowed to absorb inaccurate and unscientific ideas of the universe and astronomical bodies and to grow up with earth-centered conceptions in an age of modern science.

The Earth Is Very Old—Time

The conception of the great age of the earth and of the universe has come to mankind as a revolutionary idea. Not only has it profoundly influenced scientific understanding, but it has altered man's attitude toward his own place and function in the universe. It was natural for primitive man to think that the earth had been formed just a short time before the advent of his people. Much of this primitive belief came down into modern times and still controls thought in scattered areas. Children in their early years may learn that soil is made from rocks, and through activities, observations, and experiences discover that the process of soil formation took a long time. They may also learn something about the forces which operate upon the earth to produce changes; that it was a long time before the earth became a suitable place for plants and animals; and that many kinds of animals have lived on the earth and have become extinct. These ideas furnish him useful content in constructing his understanding of the great age of the earth.

Children may have a variety of interesting experiences with earth forces: for example, they may examine pavements broken by water freezing in winter; feel rocks softened by the action of weathering; observe erosion after a rainstorm; note how plants keep soil from eroding; examine different kinds of soil with a magnifying glass.

Time is something to be learned. Children must learn the concepts of yesterday, today, and tomorrow; the meaning of a second, a minute, an hour, a week, a month, a season, and a year; the sequence of seasons; the varied lengths of life of living things. A tree may be several hundred years old, and on the other hand, a moth may live only a few weeks.

Time is relative to both children and adults. A half hour may be a long time waiting for a plane or train, but very short if we are playing. A year between birthdays can seem a long time, but it is short in terms of the centuries the Indians have lived in the Western Hemisphere. The teacher and the parent can greatly enlarge children's concepts of time.

In later work children may learn something about what has happened to the earth, the causes of natural features in various localities, the long ages of prehistoric life, the struggle of life for existence, the forces operating on the earth, and some of the changes that have taken place on the surface of the earth. This comprehension of the great age of the earth is essential to an appreciation of the antiquity of man and of man's attempts to build social institutions for his own welfare. The goal is not the memorizing of a chronological sequence of events, but rather an approach to the modern conception of time. These ideas reveal to man the importance of building his social and political structure with the thought that he may live on this planet for some time to come, provided he uses his intelligence to assure survival. These concepts are fundamental to building an understanding of what is intelligent utilization of natural and human resources. This understanding is necessary for man's planning for his own future.

This background to an appreciation of the modern concepts of time and change should tend to inhibit chauvinism; it should teach each pupil that all life existing on the earth today is the result of a long succession of living things—a development involving a vast number of individuals and extending back to the beginning of life on the earth.

The mountains, rivers, valleys, plains, seas, and other physical features that we think of in connection with a given nation and that often come to be revered by the people of that nation have not always been there as they are now. The surface of the earth has changed its appearance many times in the past and is constantly changing today.

As the result of a long series of experiments in the art of living, man has become a dominant force in nature, and we have a right to feel a

pride in the achievement of all mankind. It must be emphasized in our instruction that this achievement is restricted to no one race or nationality.

Changes Occur Continuously in the Universe—Change

The conception of change permeates all fields of knowledge, and man must consider these changes if he is to operate intelligently with natural forces. Modern geology reveals that our physical environment does not remain constant, that the history of the earth is a story of change—change in climate, in topography, and in the succession of living things.

The conception of change is manifest not only in geological history but in living things, as, for example, the changes produced by birth, growth, age, and death. There are also changes produced by the biological principles of struggle for existence; and these cannot be ignored by man in his striving to adapt the world to his needs. Then there are the changes produced by energy and movement. Astronomical bodies are seen to have changed position and character through cycles of time. The scientist learns to look for change in his explanation of phenomena; the layman must expect change as a condition of everyday life; the student of social studies and the citizen must anticipate change in the political, social, and economic structure. Information concerning changes produced by physical and chemical phenomena, developed in terms of children's own experiences, can be introduced during early school years and continued through later levels.

Children see water disappear from a dish by evaporation. They pick up rocks which have weathered so much that the rock disintegrates into small pieces in their hands. They see the changes in the sky, in the weather, and in seasons.

Illustrations of change include such phenomena as rusting of iron, melting of ice, boiling of water, weathering of rocks, variations of weather and of seasons, and innovations produced by man's discoveries and inventions.

School windows should be utilized more fully for the study of the succession of changes due to weather, to the seasons, to the time of day, and man's activities in relation to these changes. Brief excursions around the school ground will provide varied experiences depending on the region. The children may see frozen, muddy, and dry soil; the growth of plants; and a variety of plant structure, such as roots, stems, flowers, and seeds. An outdoor thermometer may reveal temperature changes. Art work can be utilized in the study of changes.

A community of living things never remains in a strictly static con-

dition. Children can observe the changes in a weed patch near the school, in a thicket, or in a garden. There is a continual shifting caused by weather, seasonal change, and just ordinary life and growth within the cycle of new life, maturing, and death. All around children are evidences of change.

There is no exception to the occurrences of change even when man is involved. Natural forces are always present and working in an environment. Perhaps man can never control the natural forces. Rather he must learn to work intelligently with these natural forces to bring about changes which are advantageous to his best interest.

In addition, there are the great changes brought about by man's inventions and man's discoveries. Of course, children are not so aware of the significance of these changes as adults. However, the school must prepare children to meet change, for the next generation may need to be prepared for even greater changes than those met by the present generation of adults.

Man has lived through revolutionary changes in his social living because of the introduction of new forms of energy and of ways to utilize that energy. The discovery of fire, the introduction of animals to carry man's burdens, the steam engine, the electric generator, and the internal-combustion engine greatly changed man's social and economic conditions. The utilization of atomic energy is bringing and will continue to bring tremendous changes. Children should gain a feeling of confidence in the fact that they are not the first of the human race to witness revolutionary changes in energy. Furthermore, it might be well for us to know how man's discoveries of new forms of energy have brought about great potential supplies of energy for everyone. The advances in the field of agriculture and soil culture may have significant impacts on the future course of world events.

Changes brought about in a community also may be significant. What did the country look like before the earliest settlers came in? What changes have been brought about by man?

There are only about a hundred elements which enter into combinations and form the multitude of substances about us. Chemists find that some of these elements combine in so many different ways that to date they have been able to make but a small proportion of all the possible combinations. Chemists are learning to build out of cheap sources substances which in their natural states have been very rare. They have also learned how to make new substances, such as new drugs, insecticides, medicines, plastics, synthetics, and so on. In this way, science contributes greatly to an improved health, finer recreation, and higher standard of living.

Life Is Adapted to the Environment—Adaptation

Adaptation is a pattern which permeates the entire realm of living things, for wherever there is life there is adaptation. This is a conception of great significance in the modern world. Indeed, man's problem today is to adapt his social, economic, and political structure to the conditions of the environment and his own needs. In the early grades children can learn something about the homes of some animals and their adaptation to life in various places. They can be introduced to the idea that animals' structures have become modified to fit their environment. Later they can learn how plants and animals, including man, are adapted to seasonal changes. The study of prehistoric life is a story of adaptation, and can be supplemented by a study of how animals are protected against their enemies, how animals take care of their young, and how plants continue to live on the earth. Man adapts himself through community life. The advantages and disadvantages of this form of adaptation, along with a study of solitary animals, may be considered on intermediate levels. As the child matures the scope of his concept of adaptation is further broadened through a study of prehistoric modifications, of the weapons which animals use, and of the struggle for existence.

The conception of this pattern, like the conceptions previously outlined, may influence an individual at all levels of his development. It may modify the child's interpretation of simple observations of the effect of seasonal change on plants and animals. It may give substance to the youth's understanding of the structural variations of living things, and to his consideration of problems of public welfare. It may determine the adult's participation in politics and in public forums. The scientist finds much that remains to be discovered concerning adaptation. The significance of this conception in the social studies can scarcely be overemphasized.

Some of the more general facts involved in understanding the concept of adaptation are the relationships of living things to temperature, water, food, light, gravity, and certain gases found in the atmosphere; the effect of some of the limitations of these conditions upon life; the narrow range in these conditions on the earth as compared with those found in the universe as a whole; the adaptations imposed upon plants and animals that live under these conditions; the prolificness of life; and the interchange of energy and substance between plants and animals and between the physical environment and living things. Through experimentation, discussion, and reading, children learn that living organisms need light, oxygen, nitrogen, carbon dioxide, heat, water, and other conditions in order to exist and to produce young. When some of these things are scarce or too abundant, life may suffer.

The implication for international understanding is that man frequently is limited by the physical conditions of the environment to which he adjusts himself. Some people must live in inhospitable places, such as swamps, deserts, and arctic regions. These people must utilize the materials that are available for shelter, food, and clothing. It is not surprising, therefore, to find among the peoples of the earth a wide variety of customs. Many of these customs which seem foolish to others may be the results of the experiences of many generations in a given environment and may be necessary to the survival of that people.

International co-operation has become a necessary adjustment on the part of mankind if our culture is to survive.

In science studies in the elementary school, children have an opportunity to realize that man is only one of a multitude of living things, and that, like these other things, he has survived because he has made adjustments and adaptations to the environment.

The Variations of Living and Nonliving Things—Variety

On the earth there are wide varieties of climate exhibiting differences in mean temperature, in the range of temperature, in the length of the growing season, in the amount of rainfall and its seasonal distribution, as well as differences in exposure, in slope, in drainage, in elevation, and in soil. These factors create many kinds of environments and require adaptations to these environments. All around us we see in nature a variety of forms, differences in structure, sizes, habits, and life histories of plants and animals. They range from the ultramicroscopic organisms to the gigantic forms of the redwoods and whales. The life span of some living things is very short, while that of others covers several hundred years.

When we see how many different kinds of living things there are, it is not surprising to find that there are also so many different kinds of people. Man has wandered about the world for thousands of years, living in many habitats widely separated from each other. We should expect, therefore, to find different races, languages, and customs, but a concept that science may teach is their interdependence despite their differences.

No two living things are exactly alike, although they may be of the same species. We cannot, therefore, judge all people of any nation on the basis of one or two we may have known.

Variation is manifested in the physical world as well as in the biological. There are many systems of organization in the physical world—the atom, the element, the molecule, the compound, the substance, the planet, the solar system, the galaxy. There are many kinds of minerals,

soils, and rocks. There are only around one hundred elements, but there are thousands of different compounds. There is variety in the manifestations of energy. Man, too, tends to develop variety of forms in his inventions, discoveries, engineering, and arts.

Children should become acquainted with this theme by being introduced to the range and scope of certain obvious characteristics in the physical and biological aspects of nature. Instruction should be chiefly concerned with the theme rather than with mere identification of animate and inanimate objects.

Each child has two parents. Each parent brings to the child a diverse inherited background. When we consider that this means for each child four grandparents, eight great-grandparents, and so on, the tremendous potentialities working for variation in the human race become apparent. When to this observation we add the fact that each child has a different environment, the tremendous variations found in children in any classroom are understandable. Every individual is a result of success through a long span of years in that each of his ancestors is the result of two parents reaching maturity in spite of sometimes hazardous conditions.

The concept of individuality, that each individual is unique and different from all other individuals, is a part of the larger pattern of variety. Williams,[1] a biochemist, has recommended that we should start teaching children in the kindergarten that they possess individuality. His recommendations merit serious consideration by elementary-school workers. They point to one way in which science can contribute to mental hygiene. Each individual has a right to be different. He should not be amazed to learn he is superior to some of his classmates in some ways and inferior to others in other abilities. This pattern can be used to develop a feeling for the dignity of the individual, a feeling so important in a democracy.

Following are some of the aspects of variations that are illustrative of those found in the environment of children:

Changes that take place in the out-of-doors.

The many different kinds of animals.

The variety of animal noses, eyes, tails, mouths, coverings, legs.

The variety in prehistoric animals.

The different ways in which animals move about.

The differences in animal homes, such as those on the desert, in the arctic, in swamps, underground, in fresh water, on the seashore, in the ocean depths, in the forest, in the meadow, in trees.

[1]Roger J. Williams, *Free and Unequal: The Biological Basis of Individual Liberty* (Austin, University of Texas Press, 1953), p. 177.

The variety in locomotion, food-getting, breathing, and protection of animals.

Different ways in which animals grow up.

The many different kinds of plants, such as those that develop from spores, those that develop from seeds, those that are annuals, those that are biennials, those that are perennials.

The animals that are social, and those that are solitary.

The animals that are cold-blooded, and those that are warm-blooded.

Interdependence of Living Things—Interrelationship

Interrelationship is a theme which is practically universal in character. We see the significance of interrelationships as an integrating theme in many of the forces operating on the earth, for example, in the description of astronomical bodies, weather, and other physical phenomena; in the interdependence and interrelation of living things to each other and, in turn, to their physical environment; in the causes of ill health; and in the relation of pests and parasites to economic loss in the agricultural world.

Space does not permit a full discussion of how the idea of interrelationships in physical and biological phenomena may be developed. In the early years children gain experiences which lead to an understanding that some plants and animals in the garden are harmful. In later work they learn the value of certain other plants and animals and what people are doing to protect them. Attention should be focused in later elementary-school work on the problem of conservation and on preparing pupils for a more comprehensive study of the biological principles involved in the struggle for existence, in the balance of nature, and in the interdependence of life. Some of the relationships of scientific discoveries and inventions to man's progress and welfare should be considered. Man does not live to himself alone. He lives in a world of interdependencies and interrelationships. He is dependent upon earthworms and plants for the fertility of the soil. He is dependent upon birds to keep insects in check. He needs snakes, owls, hawks, and other animals to keep rats and mice in check. Spiders serve to control the number of insects. An animal which seems rather insignificant to us may play an important role in the development of conditions suitable to man.

The interdependence and interrelationships of living things to other living things and of living things to the physical environment is basic to the understanding of social issues. Physical and biological forces do not recognize national borders. A wind blowing in one country may be due to world-wide atmospheric conditions and the pressure of air in regions

within the borders of other nations. Animals do not necessarily stop at national borders unless those borders are natural barriers, and even then certain animals are known to cross many such barriers.

In science the earth must be considered commonly as an entity; a disturbance in the physical or biological world in one part of the earth may have significance to many other parts. In a community a fire in one section is the concern of the entire community. A disease or a pest in one section of the world may become the concern of all peoples. Nations, therefore, should learn to work together in an intelligent way for the welfare of all peoples of the earth.

The natural resources of a country, such as soil, oil, coal, gas, forests, and pastures, are the result of natural forces operating for millions of years. People have not created them, but they frequently waste them through carelessness and mismanagement. Man can waste in a generation or two what has been the result of titanic natural forces operating over long periods of time.

Man, if he is to remain civilized, must disturb the original balance of nature, for only savagery can exist where man does not attempt to make changes. But it is man's task to use the natural processes and resources in such a way that he secures what he needs for a high standard of living without hazarding the welfare of future generations. Man need not return to savagery nor disregard natural resources; he now has science to use in planning for the years ahead. It is incumbent upon the public schools to develop a generation with ability to meet its problems, both personal and social, with intelligence, co-operation, and resourcefulness. This calls for an appreciation of the interdependence of living things, and of the interrelations of living things and the physical forces and materials.

Balance and Imbalance—The Interplay of Forces

As one observes the many events or phenomena in his environment one is impressed by the dynamic flow of events and the energy involved in them. If one could be an observer over centuries, one would be aware of the titanic forces in operation; but seen one day at a time over the short span of a human lifetime these forces often pass unrecognized. Some, such as evaporation, seem small; yet scattered over the face of the earth, evaporation is tremendous and results finally in rain, snow, dew, frost, weathering, erosion, floods, blizzards, and other events.

There seem to be tendencies toward equilibrium and balance in the operation of forces. In a normal atom it is thought the positive electrical charges balance the negative electrical charges. It is thought that

a static electrical charge is the result of an imbalance in these electrical charges. The shock we feel or the lightning flash we see is the resulting establishment of equilibrium of these charges. Even the thunder can be thought of as a clap caused by air rushing in where the air was expanded by the heat of lightning.

We have already spoken about the balance of nature. Man has been ruthless at times with this balance and has experienced economic loss from the resulting dust bowls, soil erosion, waste of resources, epidemics, plagues, and pests.

There are forces operating also in the structure of the earth. It is thought by some geologists that in maintaining balance these forces have caused the formation of mountains, continents, and oceans. We witness earthquakes and volcanic eruptions as a part of the balancing of the earth's structures.

It should be kept in mind that the sun is a great source of energy and that it shines on the earth all the time. It shines on the other side of the earth while we are having night. It shines when it is cloudy, although there are clouds between us and the sun. The sun then is like a great solar engine which furnishes energy for green plants to grow and make food, for water to evaporate, and for the movements of air currents or wind and of ocean waves. The movements caused by the sun's energy are checked and modified by the earth's gravity, its rotation, and to some extent by friction. There is a tremendous interplay and interaction of the forces in the universe.

Wherever we look we witness the operation of forces and the many evidences of balance. In our own efforts to maintain balance and equilibrium, we also experience the operation of natural forces in and on our own bodies. Many psychologists explain learning at all levels as a process of attempting to gain intellectual balance in the face of a new situation, a problem, or a challenge.

Conservation as a Pattern for Behavior—Developing Responsibility for Our Environment

As children develop a better understanding of the basic patterns of the universe they also may acquire more intelligent behavior with reference to natural resources, including human resources.

Some courses of study help to establish undesirable kinds of behavior, as when children are encouraged to develop collections which in turn can rob the environment. Sometimes they are instructed to bring to school collections of leaves, twigs, flowers, rocks, minerals, and bird nests.

We need to develop in children a feeling of responsibility for the

environment. Conservation, or intelligent use of natural resources, consists of a kind of behavior as well as a body of content. Before moving objects, animate or inanimate, out of the environment and into the classroom, there are many major considerations which the children may discuss. To whom does the object belong? Do I have the right to take it to school? Do I disturb the environment if I remove this object from it? Am I destroying the natural beauty of the environment by removing this? Is the study I am going to make of the object one which merits its removal from the environment? Should I plan to return the object to the environment as soon as the study is completed? Can this object be studied properly if it is removed from the environment? Can I care for it properly in the classroom? If it is alive, does it have a chance to live in the classroom? Am I prepared to give it the care it needs to survive? One should keep in mind that living things are usually found in an environment to which they are more or less well adapted.

Developing Behavior Consistent with Health, Economy, and Safety

Many schools are now integrating health entirely with science and the social studies. Science provides the necessary background for the teaching of health information and the development of good health habits; therefore, a program of science in terms of problems and meanings should offer opportunity for the integration of science and health.

The relation between science and economy has too long been neglected. Because of his own ignorance of the operation of biological and physical principles, man is at present beset by a host of problems concerning international economy. Recent projects in a number of countries are helping to solve these economic problems in local environments by re-establishing in the natural forces a balance in favor of man's interests and welfare.

The relation of science to the economic problems of man is well exemplified in his struggle with pests. Man has carelessly introduced exotic plants and animals into almost all regions of the world. Many of these transplanted plants and animals, unchecked by their natural enemies and competitors, have multiplied so rapidly that they have brought havoc to the economic life of the nation. Control comes not alone from the work of fact-finding public or private scientific agencies, but also from the intelligent co-operation of the entire population. Much can be done to secure this intelligent co-operation through an integrated program of education in the public schools. Mankind cannot afford to have another generation ignorant of the elementary biological principles of nature.

Another similar problem is to find ways to prevent loss of soil through erosion. In almost any section of the world we can find examples of the terrific loss of natural resources resulting from the lack of soil conservation. Creating an awareness of this problem in order to bring about intelligent individual and community action concerning it is no small part of science in the elementary-school program.

Many species of our indigenous plants and animals have become extinct because of man's ruthlessness and ignorance. Still others are in danger of being destroyed. Man cannot continue to be ignorant of the web of life in which he is by nature involved. The elementary school, as the tool of the common people, should work toward developing a generation concerned with the wise utilization of natural beauty and resources.

We cannot fully anticipate the environment of the future. New inventions may eliminate present hazards and create new ones, making it impossible for us to develop a code of conduct in safety instruction which will be functional for an entire life span. It may be well for us, then, in safety instruction, to place more emphasis upon scientific principles which are basic to safe conduct. Children at all levels should be encouraged to enter into planning with the teacher for safety on all excursions, including the short excursion, even though it may be only to the edge of the school grounds.

Consideration should be given to what one should do in case of fire or other disaster so that the behavior is automatic. Classroom teachers and parents can have a powerful influence over the destiny of whole regions and nations by developing in children a willingness and ability to base their conduct and behavior upon sound information. Safety education, as one aspect of the goals of conservation, can well be integrated into the development of responsibility for one's own behavior and for the environment.

A Variety of Procedures

The teacher should look to a variety of procedures in teaching science. It might be well to avoid dropping into routine methods. Discussion, instructional excursions, observations, experiments, reading, use of visual aids, group work, and planning all play a part in the teaching-learning situations in science education. The teacher should consider her own interests, tempo, and rhythm along with those of the children. It is important that the teacher be happy with the procedures. It is well for the teacher to be present as a participant in all the procedures. He should be a learner, for good teaching in science involves learning.

If there is one term that can be used to specify the kind of instruc-

tion appropriate to all phases of science teaching in the elementary school, it is "developmental." In this case it is developmental from the point of view of children and teacher, both as learners. It means the instruction develops, using the experiences and knowledge children may have or that can be provided for them. It is developmental in that children may participate in the development of the planning for the use of experiences, experiments, discussion, and authentic materials to provide solutions to problems. The new learning is made acceptable to the children by the nature of its development in instruction. Children are given time to internalize new learning, integrating it with their experiences and ideas. It is important in this development to provide opportunities for an idea to be tossed about in the thinking of a group, to be tested through simple experimentation, if appropriate, or through observation, to be talked about at home, and to be checked against authoritative books.

In any consideration of teaching methods, the primary concern in elementary education is what kinds of boys and girls are being developed. All of us need to be cautious that our procedures do not become devices and ends in themselves. Therefore, evaluation should be an integral part of instruction rather than something done at the end of a period of instruction.

At all times in teaching it is well for the teacher to know at what point the children are in a given development. In this Manual suggestions are given the teacher as to ways in which he can secure this information. It is well also to find out how the children think, that is, the type of thought structure they have. Such questions as "What do you think?" "Do you think so? Why?" "Why do you say that?" "How would you get the information?" "Do you think that is information we should accept?" will give the teacher evidence as to how children think and where they are in their development.

Regardless of how the instruction at any point is initiated, vital teaching recognizes the concepts children may have on a subject or problem. So it is well for the teacher to provide opportunities for them to express their ideas, however incomplete or inaccurate, in order that misconceptions may be brought into the open. It is most important that they be allowed to express themselves without the fear of censure or ridicule, although at times there can be the enjoyment of childish humor and fun without personal damage.

Very frequently children's concepts have originality and imagination. Their concepts also provide opportunities for evaluation of preceding work and reveal the kind of instruction needed for the clarification of ideas. The authors of this series have profound respect for the natural

ideas developed by children. Every child needs an adult who will sympathetically and intelligently listen to him. If such a person could be provided for more children, we would need fewer corrective institutions.

Studying Children while Teaching Science

Teachers will find their teaching enriched if they will study children as they teach. Science with its challenging content and its rich contribution to the attitudes and behavior of both adults and children offers unique opportunities for the study of children.

The greatest concern in studying children is not how much information children have secured, important as that may be. Rather, the main emphasis should be on what kind of boys and girls we have. What kind of thinking do they do? What are their outlooks upon the world? Are these outlooks constructive and democratic? Do the children think for themselves? Are they developing good ways of thinking? Are they learning to be resourceful?

At all times teachers should be alert to the kinds of behavior changes that children are making. The teacher may ask: Are the children developing dogmatic attitudes, or are they willing to consider new ideas? Are they tending to accept every idea they hear without hesitation? Do they look for further evidence before drawing conclusions? Are they learning to use authoritative books? Do they report on out-of-school experiences in a wholesome way? Do they propose explanations? Are they learning to plan? Will they work with others?

In this kind of study it must be recognized that behavior may reflect the home and the general background of the children. A dogmatic parent may cause a child to be gullible.

It should be kept in mind that it is the behavior in which a child has had some degree of freedom of choice which is the most useful for evaluation. The closely worded or directed question of the quiz program and the rigid recitation have little significance in evaluating behavior. In a sense it is the spontaneous behavior of children—the proposal of something to do, the inquiry, the choice of language in indicating open-mindedness, the critical-mindedness, poise, resourcefulness, the challenge of a statement, the willingness to consider new ideas and to take on new duties, the use of old learning in new situations and learning—which is useful in evaluation. All of this seems to favor a type of discussion in science instruction which allows for freedom of expression and thinking.

It is recognized in this that teachers need to study children as individuals and as groups and from a total, rounded-out point of view of edu-

action. The contention here is that science with its profound meanings offers unique potentialities in studying children from this view. Children should not be evaluated as if the development in behavior relating to science were isolated from all other aspects of their lives. Science, as the interpretation of the environment, should be thought of as an intrinsic part of the life of children in the modern world, a part that may be an important factor in building desirable behavior.

A Dynamic Education for Children

The preservation and advancement of democracy depends to no small extent on the behavior patterns developed in children. We do not know what the future will be. In a sense we must educate children for uncertainty. This does not imply that we need be pessimistic about the problems these children will face in the future. Rather, we can be confident that if we assist them to develop democratic and resourceful behavior, they will make their own future.

It is the contention here that the outlook of children toward their environment and the universe is the very core of the development of a resourceful adjustment to the future. While incidents play an important part in making learnings meaningful, science should not be incidental in the lives of children. Instruction limited to talking about science and a description of objects and events is not in keeping with the dynamic urges of children and will not serve to help them cope with the problems of today and tomorrow.

There is a need for a positive and dynamic program for children, one which develops a feeling on the part of children of being needed by our democracy, in times of peace as well as war. Children are needed not alone for their own nation but to assume responsibility for work toward a better world.

There may be opportunities for children and teacher to work to improve conditions in the classroom, in the school, on the school grounds, and in the community. In this way, they can see how science is used.

Science will continue to play an important role in the lives of our children. It is a powerful tool which can be used for good or evil; and children, the adults of the future, will have to decide which way it shall be used.

It is most important to the success of our way of life that children have a favorable attitude toward science. Science should not seem foreign or exotic to them. Science viewed as the result of the age-old drive of man to adjust himself to his environment and to maintain his own equilibrium in the welter of biological and physical forces carries

with it a larger point of view than a purely vocational one. Science is the result of man's experience and logical thinking through the centuries. Science, like democracy or the mother tongue, belongs to all who wish to make use of it. Children should be made to feel that science belongs to everyone.

Science instruction should be a pleasant experience for both teachers and children. Teachers should feel relaxed with children while teaching it. Interest in science should be maintained at all levels. The instruction should be freed of assignments involving busy work and meaningless drudgery. Exhaustive and overly specialized units should be avoided.

Boys and girls must learn to handle and to experiment intelligently with the forces and materials of the universe. Unintelligent tampering and carelessness bring disease, ugliness, waste of natural resources, unemployment, poverty, war, and widespread unhappiness. Children must develop a poised, well-balanced, yet realistic outlook upon the modern world. They must learn that by working resourcefully and intelligently they can create their own world.

GERALD S. CRAIG

Purpose and Plan of *Science Near You* and *Science and You*

Science Near You is the second book in the series SCIENCE TODAY AND TOMORROW. It follows the primer, *Science and You,* and is based on the purposes of science in childhood education as presented in the Foreword. These books are designed for children in their study of science at school, regardless of whether or not they can read. The children who do read at this level will profit greatly by using these books. They are useful also, however, for children who read very little or not at all.

Science and You, the primer, is designed for introducing children to science in the first few months of the first grade. Since it treats with many familiar experiences, it can be used by children who have not learned to read, as well as by those who have acquired some reading ability. The experiences and learnings set forth in the primer furnish a basis for *Science Near You* and the books which follow it in the series, SCIENCE TODAY AND TOMORROW. Therefore all children at the first-grade level may profit by using the primer and *Science Near You.*

This Teachers' Manual for *Science Near You* will be of assistance to you in helping children develop rich fundamental learnings in science. By using the Manual you can have a successful and happy experience in teaching science to children regardless of whether or not you have studied science previously. Both *Science and You* and *Science Near You* with their accompanying manuals may help you in the teaching of science in your classroom.

The content of both children's books has been selected with care by the authors, who have had experience working with young children in various types of schools and in different parts of North America. The books include material concerning areas of wide geographical range, and aspects of environments common to all the areas, such as rocks, soil, air, water, machines, magnetism, sounds, sky, weather, and living things. Through various situations of concern to young children which involve listening, feeling, tasting, smelling, and looking, provision is made for gradual concept development.

Many illustrations are used in *Science Near You* as well as in *Science and You.* They have been designed for the purpose of stimulating children to draw upon their own experiences, to question and wonder, try

out their ideas, and make observations as they attempt to interpret and adjust to their environment. Some illustrations involve experiments and suggest *try it* or *let's find out.* Others encourage observation and interpretation of what is near the child. Many stimulate children to recall their past experiences; others encourage them to review the way they go about their thinking or lead them to sense as well as state questions and problems. Other more specific purposes will be pointed out for each picture in the discussion of the chapters. These illustrations have been planned around meanings which help to explain phenomena concerning living and nonliving things. The situations are designed to stimulate discussion on the part of children. When children are encouraged to speak about their own experiences, the learning becomes more real to them. Each illustration has been checked and rechecked for accuracy.

A small amount of text is used in *Science Near You,* but titles only accompany the illustrations in *Science and You.* The text and titles are planned to focus the attention of children on the meanings involved in each situation. By using these two books, young children have an opportunity to extend their experiences without being handicapped by the need to develop an extensive reading vocabulary.

The order of chapters has been worked out on the basis of an all-round study of six-year-olds and of science. You may wish to use the chapters in this order; however, you should feel free to change this arrangement if it seems best to do so in your situation. Perhaps certain chapters will be used before others to vitalize new interests or open up new experiences and new areas of science. Or the content of a particular chapter may be related to what your boys and girls are concerned with at a certain time. If so, by all means introduce it then.

By using the primer the children will have opportunities to extend their experiences, create new interests, develop learnings in areas of science new to them, and be guided in making interpretations. As a result, they may develop a good background for using *Science Near You,* and, in turn, the later books of the series at higher levels.

Using the Teachers' Manual for *Science Near You*

This Manual is designed to assist teachers in helping young children draw upon their experiences as they use *Science Near You.* The ideas given here are only suggestive. They may be modified and expanded according to the needs and concerns of a group of children, the need for building new areas of interest, the possibilities for science experiences in the neighborhood environment, conditions around the school, and various other factors. For each chapter of *Science Near You* there is a corresponding chapter in the Manual. While trying out the suggestions

given here and observing the changing behavior of boys and girls, there will be many opportunities to gain insight into the ways science contributes to the lives of young children. Each chapter in the Manual is developed according to the following organization:

Introduction	Materials Needed
Science Meanings for Children	Further Experiences
Information for the Teacher	Evaluation
Ways of Working with Children	Bibliography

Introduction

The introduction to each chapter gives an overview of the material presented there. It refers to the kinds of experiences six-year-olds might have in relation to the particular content of a chapter. It points up the significance which this content might hold for young children.

Science Meanings for Children

When children refer to their own experiences and to situations presented in *Science Near You*, there is need to focus their attention on the science meanings involved. Emphasis may be given to these ideas through questions, such as: What might John find out when using his magnet? How can you tell that air is moving? How have you seen the sky change? In what ways do you care for your dog? When boys and girls develop large meanings, such as magnets attract some things, air moves things, or the sky changes, they have a basis for making interpretations.

The science meanings developed in *Science Near You* are based on the large science patterns of change, adaptation, variety, interrelationships, balance, time, and space. These patterns have been presented in the Foreword. In the first part of each chapter in the Manual is a list of the science meanings involved there. They also occur in the page-by-page development of the chapter in relation to suggested ways of working. Some of them are stated in *Science Near You* as the content is gradually developed for children.

Information for the Teacher

The material at the beginning of this section in each chapter of the Manual points out ways science has touched the lives of young children since their birth. This introduction might be helpful in thinking of the potentialities of six-year-olds and of how to utilize their intense drives. Also it might offer clues for interpreting their ways of behaving. For further help in learning how the content of science affects the lives of

young children and how it contributes to their development, you may wish to refer to *Science for the Elementary-School Teacher*, by Gerald S. Craig.

The rest of this section is devoted to science content in order to give a working picture of the material in each chapter. Here the meanings to be developed with six-year-olds are presented in a larger content for the teacher. As a result, more facts are given than will be used with young children. It is hoped that this material will offer explanations and interpretations that will help you in thinking through what you want to do to assist children in their concept development and in ascertaining what experiences they might have. For additional interpretation of science content also you may wish to refer to *Science for the Elementary-School Teacher.*

Ways of Working with Children

When working with boys and girls, science experiences should be considered from a developmental point of view because they are part of the earliest learnings of children. Science learnings begin at birth, which means that during most of his waking time a child is finding out about his environment. By the time he enters school, he has made innumerable interpretations, many of which are very significant to him as he makes adjustments to the world around him. By trying out ideas gained from using *Science Near You*, children may have rich experiences which will help them extend these experiential learnings.

Each child learns in his own way as he attempts to orient himself. He feels of smooth and rough rocks, listens to sounds around him, tastes sugar in lemonade, smells freshly baked cookies, and watches the way a mother hen cares for her chicks. Many of his learnings come through his muscles. He experiences the force of wind as he braces his body against it. He gains a motor sense of variation in elevation as he walks up and down a hill. At times a child's whole body is involved in a learning experience, such as feeling wetness and coldness during a rainstorm. It is through such experiences that much of children's interpretations come; therefore, their experiences are considered significant in the field of science education. In keeping with the developmental point of view, *Science Near You* presents situations which illustrate how children might gradually develop science meanings through sensory experiences in everyday living. Many ways of working are suggested in the Manual for providing this kind of learning environment for young children.

As boys and girls follow natural drives their great urges lead them to manipulate, investigate, and discover for themselves. Thus they have a wide range of experiences with living and nonliving things as well as with

various forces operating in the universe. Much of the manipulation carried on by a young child is closely related to play activities. From the developmental point of view play experiences can be significantly productive in developing science meanings, helping a child become more resourceful in his behavior, and creating opportunities for learning to manipulate materials with safety. As a result, children need the approval of their teacher in carrying on a great variety of such activities in the school environment. When constructing trucks and trains to be used in their play, boys and girls enlarge their ideas about the significance of wheels and thus gain some feeling for energy. Playing with objects in a tub of water offers opportunities for deriving the beginnings of meanings involved in buoyancy. Likewise, by running toy trucks up and down a long inclined board, children may gain some idea of how people are helped by using a ramp.

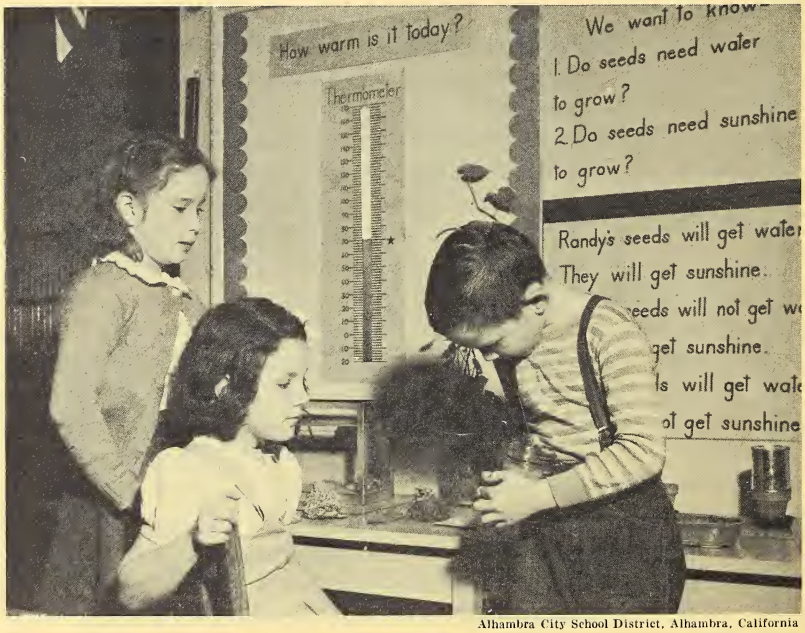
A child continually tries to identify himself with his environment and make adjustments to it. He may not have the words to help him shape his thinking or communicate it to you, yet he may have gleaned meanings of much significance which help him make interpretations. Even though he may not use words, he may communicate with you after making a discovery for himself through a look of satisfaction, a quizzical expression, an attempt to show others what he has found out, or by his repetition of the activity. When using *Science Near You*, children may be led to recall such experiences and be stimulated to talk about them in their own language. Through guidance of the teacher, children can be helped to gradually develop skill in expressing their ideas to others.

Discussion · Through discussion one may learn something about the structure of a child's thinking, that is, what he thinks and how he comes to accept a belief. Does he accept everything he has heard? Does he question? Does he take time to think through ideas? Does he draw upon his experiences? How do ideas in the book fit into his thinking? His spontaneous expressions may also be helpful in finding out about his attitudes, his way of behaving, and the concepts he holds. Adults can assist him by creating a situation in which he has time and feels free to tell about his experiences in his own language, set forth his ideas, and discuss them with other members of the group.

Young children vary in ability to carry on a discussion, as well as to be attentive in listening to the contributions of others. Sometimes a child flits from one activity to another and, as he goes, makes a few comments, asks a question, or carries on a short conversation with someone. Gradually he develops the ability to come together with a small group of children for the purpose of sharing ideas. Discussion is developmental

in nature and, therefore, at times it is appropriate for a teacher to encourage young children to talk in small groups rather than expect all members to gather together at the same time. As children mature there is increasing evidence of some boys and girls being able to sit with a group for an extended period for an exchange of ideas.

Because adults know the content involved in a situation, they are sometimes prone to cut off the discussion and other experiences of children too soon. Also they may interrupt or arrest the spirit of inquiry by feeling that they must answer all the questions. Instead, boys and girls can be offered profitable experiences when stimulated to discuss their ideas relative to such questions as: What do you think? How can we find out? How can you show that what you think is true? All this takes time, it is true. However, children need time to internalize a new learning, that is, to reflect upon it and integrate or fuse the learning with their own ideas, if it is to become acceptable to them.



Alhambra City School District, Alhambra, California

By doing experiments children develop experiential learnings concerning conditions necessary for the growth of seeds.

Experimenting · One concern in science is to know how to secure reliable information. A teacher may share this phase of the scientific method with six-year-olds as they do experiments together. She may ask questions, such as: What makes you think it happened? Why do you say that? How can we find the answer? How can you show us? What

do we need? How does this help us? Through such questioning, a teacher may offer guidance to boys and girls as they do experiments in solving their own problems.

When discussing the experiments, children may be led to speculate and give reasons for their guesses or proposals. This procedure should be followed by providing an opportunity for them to experiment and to test their proposals. For instance, after speculating as to whether or not there is air in a particular bottle, a child might hold the bottle under water in a large container so that other children can observe air bubbles rising from the bottle in the water. Thus they gain evidence that air was in the bottle. Such experiments help boys and girls clarify their concepts and make interpretations.

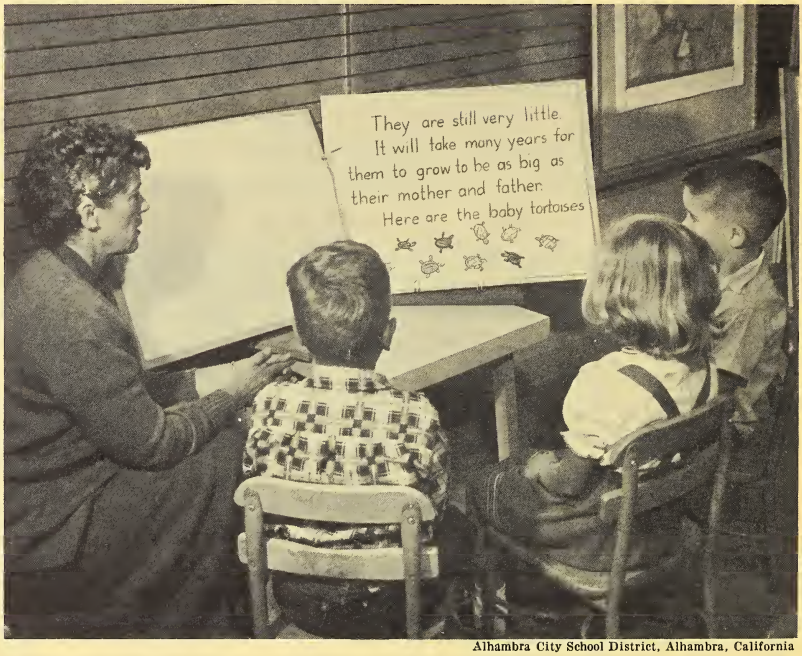
If children are well acquainted with materials they are using in an experiment, they may be able to make interpretations readily. The materials suggested in *Science Near You* can easily be obtained at school, at home, or from other places in the local community. When environmental materials, such as glasses, flowerpots, a paper sack, and spoon, are used at school, children are more likely to try the same activities at home where similar materials are available in the kitchen, garage, and other places. Boys and girls are usually resourceful in suggesting materials which can be used.

The experiments presented in *Science Near You*, as well as those suggested in this Manual, have been studied from the standpoint of safety. Materials used in these situations have been considered in relation to the safety of children at home as well as at school. Boys and girls should be guided to use procedures which tend to prevent accidents and to alleviate fears.

Reading · When helping children read this science book to find out more about the land near them, the sky, how plants grow, and other information, it is suggested that desirable directed reading procedures be followed. The text helps to formulate the science meanings developed in each chapter. A number of science words are introduced, such as *attract, experiments, ramps, sky, moon, rocks, feel, grow, blow,* and *dissolves.* Such words carry meaning for boys and girls when experiences are provided for concept development, and when opportunities are offered for using the words in conversation. For example, as the children tell about their experiences with a magnet the word *attract* might be used many times. *Ramps* might become a well-known word through observation and discussion. As a result, children may readily add such words to their oral vocabulary and later be able to read them easily.

Six-year-olds may participate in developing material they can read. Frequently they have reasons for keeping a record of an experiment,

listing questions or problems the group wish to consider, recording their plans for a walk, listing findings gained when they visit a park, or recording weather conditions for the week. Sometimes these records may be dictated to the teacher by individual children, and at other times they may be developed by the group working together. When these are written on large charts, they can be read and used by the children as needed. Other reading material involving science content may be created as children dictate captions for their paintings or similar items.


They are still very little.
It will take many years for
them to grow to be as big as
their mother and father.
Here are the baby tortoises

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These children are reading a story they created after seeing young tortoises hatch in the classroom.

Sometimes they may suggest headings involving a science meaning to be used on the bulletin board with the pictures they have selected. By reading their own charts, captions, and booklets, children may deal with science content and develop a vocabulary helpful to them as they read *Science Near You.* A variety of ways are suggested in this Manual to guide children in making records which may re-enforce their science learnings and lead to better development of the concepts involved.

Taking Walks or Longer Trips · Boys and girls may have need to take a short walk to see an anthill, young chicks, rocks in a vacant lot, the results of a rainstorm, or machines operating near the school buildings. Even a short walk to the edge of the school grounds may be helpful in clarifying concepts. Sometimes it is advisable to take a longer trip

into the neighborhood if a school bus is available. *Science Near You* suggests many possibilities for study walks and trips. In some school situations it may not be possible to take such study trips. However, this book can be used quite successfully even though this procedure is not used. For instance, there will be frequent occasions for children to make observations from windows in the classroom or hallways. Much can be seen from windows as children watch the rain, changing cloud formations, swaying trees, changes in plants, or activities of animals.

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Reading material dictated by the children has been made into a movie which can be rolled back and forth.

At other times the group may profit by walking around the building to see where machines are used when an interest in them has been developed by reading the book. Possibly when using the chapter "Young Animals," a child might invite the group to go to his home to see how his dog cares for her puppies. A number of walks might be initiated through the use of the book. On the other hand, a trip might lead the children to go to the book for information or to check what they have observed on a walk. This Manual suggests ways of working with children while taking walks or longer trips.

During a walk help the children develop a feeling of responsibility for what they see around them. The leaves, flowers, insects, toads, and

nests are needed in the environment. Therefore, encourage boys and girls to learn about animals and plants in places where they are found. However, if it seems advisable to take an animal, plant, or other material into the classroom, you and the children need to ask yourselves: Do we have a right to move it? Do we plan to use it in an important way? In what way will we disturb the place where it lives if we take it with us? Can we care for it well in our classroom? How soon can it be returned to its place? By helping children think through the problem in this way, they may learn to assume responsibility for their environment and develop an intelligent way of behaving toward it.

In studying plant and animal life it is not necessary, and frequently is actually undesirable, to provide children with the names of the various kinds, or species. This Manual will indicate various approaches to the study of plants and animals without using the names of any that are not more or less familiar to children. The teacher, therefore, need not feel any embarrassment because she is unable to identify plants and animals.

Materials Needed

Materials needed for carrying on activities are listed for each chapter. Usually they can be obtained in the local environment.

Further Experiences

To provide for individual differences of young children, a variety of additional activities are suggested in this section of each chapter of the Manual. As boys and girls explore situations offered in *Science Near You* some may develop interests which lead them to try out activities not given in the book. Also, those individuals who are more mature than others need additional experiences to extend their learnings and to challenge their potentialities. The whole group may participate in some of these activities, and only a few boys and girls may carry on others.

Evaluation

In each chapter of the Manual suggestions are given which may be helpful in taking a look at your work with young children. As you study your group while they are using *Science Near You* you will have opportunities to gain information about the ways individuals are forming concepts and how their behavior is changing. How are they expressing themselves relative to the large basic pattern of change? For instance, in what ways are they reacting to the changing sky, the changing conditions in plants, and the erosion of soil? Are they observing variation in rocks, making comments about variation in weather conditions, and reacting to the variety of animal life around them? Similarly you may

notice that the children are adjusting to the other large basic patterns of balance, adaptation, interrelationships, time, and space. (These patterns are discussed fully in the Foreword.)

What spontaneous reactions involving science learnings do you hear as individuals tell about their experiments, observations on a walk, their paintings, and the way they felt as they touched something rough, smooth, soft, or sticky? Who shows evidence of the spirit of inquiry by asking questions and searching for information? Which children are becoming more resourceful in speculating or proposing ways of solving a problem, such as finding out if there is air in a jar or if magnetism goes through glass? Who suggests that they check their proposals by using a book or doing an experiment? In what ways do they show ability to plan for a walk or for an experiment? How well do they persist in carrying out these plans?

Which children are showing more readiness to listen as boys and girls tell about their experiences with such things as magnets or moving air? What improvement is shown in willingness to concentrate on an interest for a longer period, if only a few minutes longer? What evidence is there that Gary, for example, is showing a willingness to consider new ideas, or that Ruth and Tom are growing in ability to think through ideas before drawing conclusions?

There are other ways of evaluating progress in growth of children. Which interests seem to continue from one day to another? In what way are individuals who once were complacent beginning to show initiative? Which children are destructive in working with materials? Which ones are timid about manipulation and overly cautious? Some children may be growing in their thinking (becoming resourceful) about what will happen (recognizing consequences) if they do certain things (accepting responsibility). At times they may also show behavior which is irresponsible and impulsive.

Bibliography

A bibliography is given at the end of each chapter, which a teacher may wish to use in extending her own background for teaching science. Some books are listed for children's use. Addresses of book publishers are listed in the Appendix.

Suggestions are given also for audio-visual materials which may extend the science learnings of young children. There are film libraries in nearly every state conducted by departments of education and other state agencies, universities, public libraries, and museums. Information about them can be obtained from your department of education. A directory of national film rental agencies is included in the Appendix.

The Vocabulary of *Science Near You*

Science Near You is designed for easy reading in the first grade. The total vocabulary is 178 words. Of these, 93 are introduced and taught in the vocabulary of the preprimer and primer of the GINN BASIC READERS. These 93 words are assumed to be known to children in the first grade.

Science Near You also uses 85 new words necessary to the development of science concepts. The 17 starred words in the list of new words are found in the first reader of the GINN BASIC READERS. No more than two new words are introduced on any one page and every new word is used four times or more. All variants of known words are counted as new words except those formed by adding *s, 's,* or *es.*

The new words are listed by pages below. The words assumed to be known are listed alphabetically.

Known Words		*New Words*		*Total*
93	+	85	=	178

New Words

4 . . .
5 clothes
dry
6 needs
wet*
7 into*
air
8 . . .
9 many
things
10 animal
11 these
12 may*
how*
13 their
14 seen
15 which
16 young
care
17 them
18 does
19 . . .
20 . . .
21 there*
no*
22 . . .
23 . . .
24 magnets
John
25 attract
26 . . .
27 experiments
28 David
29 move
30 . . .
31 show
32 . . .
33 an
easy
34 hard
Ann
35 . . .
36 men
ramp
37 find*
38 changes
sugar
39 lemonade
made
40 dissolves
salt
41 . . .
42 around*
43 feel
44 glass
45 cork
why
46 Miss*
Mills*
47 bubbles
48 . . .
49 . . .
50 sky
51 . . .
52 clouds
sun*
53 moon
54 night*
55 . . .
56 rocks
near
57 soft
break
58 rough
smooth
59 kinds
60 land
lives
61 shovel
62 far
river
63 hill*
64 sand*
65 . . .
66 . . .
67 map
68 . . .
69 places
70 . . .
71 . . .
72 grow*
73 flowers*
74 . . .
75 . . .
76 seeds
77 sunlight
food
78 part
79 grass
80 soil
81 . . .
82 wash
83 hold
84 . . .
85 . . .
86 blow
wind
87 . . .
88 cows*
89 . . .
90 . . .
91 people
pond
92 . . .
93 . . .
94 . . .
95 . . .

Words Assumed to Be Known

a	good	my	then
and	green	new	they
are	has	not	this
at	hat	now	to
away	have	of	too
Betty	he	on	tree
big	help	our	truck
blue	here	out	up
boats	home	paint	walks
box	house	Patsy	wants
can	I	plants	water
children	in	play	way
colors	is	put	we
did	it	red	went
do	kitten	ride	what
dog	know	run	where
down	laughed	said	will
ducks	like	see	with
fast	little	she	work
father	look	some	yellow
for	makes	something	yes
fun	Mary	take	you
get	mother	the	your
go			

I

Water

The first chapter of *Science Near You* can be used to help six-year-olds develop an awareness of the evaporation of water, which is a common occurrence in the environments of children and adults. It is found in all climates and in all regions. It is something that goes on about the child all the time. It is something with which children can have a variety of experiences. Because experiments can be set up which utilize this phenomenon, and because it is an experience involving all age levels including very young children, it has been selected as the first topic of *Science Near You*.

Phenomenon is a word useful to us in teaching science; therefore, it will be used many times in this Manual. A phenomenon is a happening or event at home, school, outdoors, in the sky, or anywhere else that can be described or explained. Phenomena may be simple, ordinary, everyday events, such as a falling ball, a raindrop, a rainbow, fragrance of a flower, or a rusting nail. They happen in the lives of everyone, including children. The teacher can think of a phenomenon as something which has happened or is happening. The term need not be used with children.

Both boys and girls frequently imitate activities of the home as they play with their toys. They like to use water in their play and, as a result, they experience the fact that water makes things wet and that in time things dry. Sometimes boys and girls may wash their doll clothes, as shown on page 4 of the book. During such an experience children may be prompted to discuss their ideas about the wetness of the doll clothes and the disappearance of water from them.

Sometimes children find that water has disappeared from their paints and they must add water. When paintings are finished, they are put aside to dry. The water disappears. Do the children know why the pictures dry or what happens to the water? They may find that their paste is too dry or that the clay will not mold easily. Even though they have had such experiences, they may not have a basis for

interpreting what happens to the water. The situations presented in the children's book may help in the formulation of ideas about evaporation that are related to children's activities.

By observing the expressions of your group and listening to their comments, you may hear of other significant experiences they have had which involve evaporation and the wetness or dryness of things. They may exclaim over their wet rain clothes after coming to school in a rainstorm. They may comment about the wetness of everything they saw outdoors that morning. From observations children will gain a background for making interpretations.

After guessing about what happens to water when it disappears, the children need to test their ideas. In order to do this and learn more about this phenomenon, boys and girls may experiment with the evaporation of water as shown on page 8. The book might be introduced to further such an experiment or other experiences which involve ideas about water. On the other hand, *Science Near You* can be used to open up the topic, develop curiosity about the disappearance of water, lead children to observe situations where this phenomenon is taking place, and prompt them to try out their ideas.

Situations in everyday living which are familiar to boys and girls are presented in the chapter so that much meaning can be brought to each page. As a result, the children may have various ideas to discuss with one another. Their interest and curiosity might be aroused to the extent that they will carry on a variety of activities at home as well as at school.

Science Meanings for Children

Even though a child has had various experiences with water all his life, and has gained much information about its characteristics, he may not have developed the following science meanings:

Water makes things wet.
Water goes into the air.
Many things can dry.

The purpose of this chapter is to guide children's thinking toward large ideas about water, lead them to wonder what happens when wet things dry, and encourage them to make many observations and interpretations. These science meanings are related to energy which is involved in the large basic science pattern of change.[1] When water evaporates, it changes form and becomes part of the air. Heat is involved in this change. This heat is energy. These ideas are expanded in the next section.

Information for the Teacher

The everyday activities of a young child provide opportunities for him to develop experiential learnings about water, including its wetness and the way it disappears. The baby splashes in his bathtub, pours water from one container to another, and feels the wetness of water as well as the effect of dryness. He experiences the sensation of coolness resulting from evaporation. When he is older, he likes to wade and jump in water, run through the spray of a sprinkler, walk in the rain, and play in puddles. He enjoys using a sprinkling can, pouring water on the sand pile, letting water run in ditches, and making mud pies. Often the three- or four-year-old exclaims about the wetness of his body, his damp clothes, the wet mud pies, dew on the grass, or the splash of waves. Besides these experiences, the child uses water to bathe, to wash things, and to drink. Sometimes he waters plants or gives animals a drink. In addition, he observes other people using water in different ways.

Even though a child observes the disappearance of water, he may not be aware of what happens to it. His clothes dry after being out in a rainstorm; his hair dries after a shampoo; the windowpane dries after a rain; or water he pours into the birdbath disappears. However, in time, he may become curious to know why water disappears. Gradually boys and girls make ever-enlarging interpretations of such experiences and deepen their concepts.[2] In order to give guidance in concept formation, a teacher may wish additional information about this phenomenon. Of course, some of the facts presented here will not be used with young children.

Water is constantly evaporating from oceans, lakes, streams, puddles, and reservoirs. It is escaping into the air from soil, clothes on the line, the wet street, the lawn sprinkler, and foods during their processing.

[1]For a further discussion of the large pattern of change, see the Foreword, pp. xviii–xix.

[2]John G. Navarra, *The Development of Scientific Concepts in a Young Child: A Case Study* (New York, Bureau of Publications, Teachers College, 1955).

Plants are constantly losing water as it passes into the atmosphere from their surfaces. Some moisture escapes into the air as a result of body perspiration. The air which is expired from the lungs of animals, including people, also contains much moisture. Since some water is always going into the air, children will have many experiences with this changing condition throughout their lives.

Evaporation is the process by which water goes into the air. For this to happen, it is necessary for water to change its form. Let us see what takes place during this change. It is thought that water may be made up of tiny particles which are in constant motion. In fact, they move so fast and with such force that they fly into the surrounding air. When this happens, the tiny particles of water pass among other tiny particles of gases in the air. Sometimes this change takes place more readily than at other times, such as when either the air or water is heated. When both air and water are heated, evaporation is even more rapid.

Energy is involved as water changes its form. This energy is in the form of heat energy and we may just call it heat. Sometimes the heat which evaporates water is from the sun. Sometimes it comes from our bodies or from a stove. Therefore, as children have experiences with evaporation, they may also be building a background relating to energy. To develop growth in concept formation, there is need to guide children's experiences toward this larger concept of energy as well as that of change.

We are very fortunate that water can go into the air. If this were not the case, all the water around us would sink into the ground or run into the ocean. There would be no rain, snow, fog, hail, frost, or dew. Then, too, there would be no creeks, rivers, or lakes. Your children might speculate as to what their world would be like if water could not go into the air.

Ways of Working with Children

There are many ways to start with children in developing ideas about the way water goes into the air. The chapter may be introduced for the purpose of leading them to question what happens to water from their wet clothing, why puddles disappear, or why the paste dries. Instead, you might begin by using the book to help children who have had experiences with water that lead them to wonder and express a desire for more information.

Pages 4–9 · Water

Water makes things wet.

Page 4 · The purpose of this page is to develop the science meaning, water makes things wet. If any of the children have washed doll clothes,

this page will have special significance for them. What spontaneous comments do they make concerning their own experiences as they talk about Ann and John washing the clothes of their dolls? Encourage discussion about the wetness of their own doll clothes and how wringing helped to remove some of the water. It may be possible for children to wash doll clothes at school. If so, there will be many opportunities to emphasize the science meaning involved here.

This situation may remind some child of sensations he had when observing his mother wash clothes or when he helped her hang them on the line. As he tells about his experience lead him to describe and em-

Imaginative play may lead to experiences with various phenomena, including evaporation.

Los Angeles County Schools

phasize the wetness of the clothes and how differently they felt when dry. Other children may be prompted to tell about similar impressions.

Washing clothes is only one situation pointing up the meaning developed here. Children may tell how they felt when walking to school in the rain, and how the sidewalks, streets, buildings, cars, animals, and plants looked. During a rainstorm observations might be made from classroom windows to see how the rain makes things wet near the building and later how the water disappears. While the children are watering plants observations can be made of changes in the appearance of the soil as the water wets it.

Water goes into the air.

Page 5 · Ann's and John's activities may stimulate children to recall similar experiences they have had in drying clothes. They might discuss

their observations and question why the water disappeared from the clothes they washed or from the ones their mothers washed. Help the boys and girls read the text to find out what the book says about the wet clothes. If the vocabulary has been developed orally while talking about this situation, the children may be able to read the sentences readily. They will need time to discuss what they find out.

What spontaneous reactions do the children make as they discuss the activity in the illustration shown at the bottom of the page? Why do they think Ann and John are taking the clothes off the line? How might the clothes feel? Offer help in reading the text and encourage the group to advance their ideas in relation to the questions asked.

What reactions do the children have while discussing the material on these two pages as well as when talking about their own experiences? Are they saying, "I know," or are they ready to say, "I think"? What interpretations are they making about the changes they have observed in relation to evaporation? Are they questioning magic as an explanation for the disappearance of water? By observing the reactions of your group, you may gain much information as to where they are in their thinking and what attitudes they hold.

Many things can dry.

Page 6 · This page may be used to help boys and girls find out that water evaporates from the paints they use in the classroom. It is possible that some children may have discovered this fact for themselves. If so, the page may be used to call attention to evaporation and stimulate questioning about it. The children may tell about their similar experiences and discuss reactions to the following questions: Why is Ann pouring water in the jar of red paint? What does the book tell about the paint?

Proposals in the form of questions or possible explanations may be made by the children in answer to the question given in the book. Where do the children *think* the water will go? What interpretations are they making? Do they exhibit a desire to find an explanation? How do they show that they are ready to test their ideas? Information gained here by the children may be applied to everyday situations at home as well as those in the classroom.

Learning that evaporation takes place in numerous situations may be developed through carrying on several activities. By using a wet sponge to make a wet streak on the floor or sidewalk and then observing the disappearance of the water, attention can be focused on this idea. Lead the boys and girls to find out whether their hands will dry if they do not use a towel. You might encourage further discussion by asking:

Why does the paste and modeling clay become dry and what can be done to keep them moist? Did you observe the disappearance of water from the birdbath or pet dish? Did the animal drink all the water? Where do the children think it went? If they have a garden at school, the dry soil may be observed and plans made to water the plants.

Many things can dry.

Page 7 · Children's past experiences with animals might be utilized as this page is discussed. As they tell about their pets being wet encourage the children to consider how the animals became dry. Lead the children to wonder what happened to the water. Discuss the wetness of the dog pictured at the bottom of the page and why he will become dry. Do they think he will be able to shake off all the water? If not, how do they think his fur will dry? After reading the text, they may discuss their proposals in relation to what the book says about the water.

Expand the meaning presented here through discussing other situations involving evaporation. Have the children noticed that water disappears from places around their homes or on the way to school? They might mention dew on the grass, wet sand in their sandbox, puddles in the road and wet sidewalks after a rain, among other situations. In time, summarizing statements may emerge, such as, many things can dry.

Water goes into the air.

Page 8. You Can Do This · In several places it has been suggested that children speculate and make proposals about what they think happens to water when it disappears. This page is designed to inspire children to try out their own ideas by doing experiments. After discussing the experiment shown here, children may decide to try it.

Help the group interpret the first situation by asking a number of questions, such as: Why do you think Ann is pouring water into the glass? What do you think the children will find out? Why have they placed the label on the glass? In what way is Mary helping? Why is it important to cross out days on the calendar? While discussing the second picture encourage the children to speculate about what happened to the water Ann poured into the glass. The time element involved in the experiment can be emphasized by children counting the number of days crossed out on the calendar. These days indicate the time it took for water to evaporate.

As a result of such a discussion, children may be ready to test their ideas and prove that water goes into the air. If they place a label on a glass or jar to indicate the water line, they can easily determine when

part of the water has disappeared. It is suggested that only a small amount of water be used so that all of it will evaporate in a few days. Weather and climate affect rate of evaporation. Some days water evaporates more rapidly than at other times, depending on the amount of moisture already in the air. This kind of experiment offers an opportunity for children to check their proposals, clarify concepts, and make interpretations. It may stimulate questioning and careful observation. It may lead boys and girls to see the importance of recording data.

While doing their experiment the children might plan to record the number of days it takes for the water to evaporate. This can be done in a variety of ways. The following chart illustrates a type of record which is different from the one shown in the book.

When Will the Water Disappear?

Tuesday	1 day
Wednesday	2 days
Thursday	3 days
Friday	4 days

Page 9. Where Will the Water Go? After the children consider a great many situations and focus their attention on the meanings developed in this chapter, they need an opportunity to summarize their learnings. The question at the top of the page is developed for this purpose. Before drawing conclusions, boys and girls should not only consider the situations shown here but they should also refer to numerous other experiences they have had.

Individual pictures might be painted to illustrate different situations involving this phenomenon. These may serve as one form of summary when they are placed on the bulletin board along with captions dictated by the children. The captions might relate to the disappearance of water or the wetness of objects. The children might participate in helping arrange the pictures on a bulletin board in such a way that the two meanings developed here are emphasized. A number of appropriate pictures might be placed under such a title as "Where Will the Water Go?" Another part of the bulletin board might contain pictures under the title "Many Things Can Dry." In order to select and organize these

pictures under the appropriate headings, it will be necessary for boys and girls to apply their learnings. This kind of activity serves to summarize the findings and leads children to make interpretations and utilize their information.

As a result of all their experiences with evaporation, children may begin to generalize, draw conclusions, and state in their own words such ideas as water goes into the air, and wet things can dry. Also they may have gained some ideas about how water continuously disappears into the air around them.

Materials Needed

For use with *Science Near You*:

calcimine paints	jelly glass	soap
clothesbasket	label	sponge
clothesline	magazine pictures	washboard
clothespins	newsprint, 18″ × 24″	washtub
doll clothes	pitcher	water

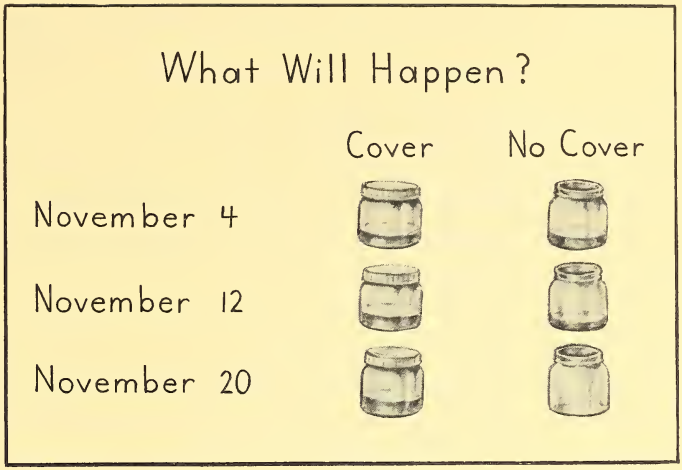
For use with Further Experiences:

jar cover	piece of cloth
jars, 2	piece of paper

Further Experiences

Proving That Water Evaporates · Even though the sensation of wetness has been experienced many times, it might be advisable to try some experiments in order to concentrate on the science meaning developed here. The children might suggest a number of plans, such as wetting a piece of cloth, paper, or other material appropriate for this purpose. As the boys and girls hang up the wet materials encourage them to anticipate how the feeling and appearance of these things will change as they dry.

Finding Out When Water Evaporates · Children may plan and carry out experiments similar to the one shown in their book on page 8. Help them to develop resourcefulness by encouraging them to suggest other experiments they might try. For instance, the same amount of water may be poured into each of two jars. If one is left open and the other covered, it will be possible to compare the results when one condition affecting the evaporation of water is changed. If a record is kept showing the water lines in the two jars and the date when the experiment is started, there will be a graphic illustration of the results from which a comparison can be made. On a chart the children might illustrate the jars of water, showing conditions when the experiment started and the results on the last day. Variations of the chart on the next page may be used.



Evaluation

If children become interested in the evaporation of water, they may refer frequently to their experiences at home and at school where they noticed that water disappeared. If they are developing an inquiring attitude, questions may be heard, such as, "Why is the grass dry now?" "Where did the puddles go?" "Why did the paste dry?"

When listening to spontaneous expressions of children, much can be learned about their ideas concerning clay that was too dry to use, the way they felt when they splashed in the tub, or an experiment they have tried. How do their concepts of this phenomenon change? Sometimes a change in vocabulary reveals progress on the part of some of the boys and girls. Are a few beginning to say, "I think," rather than "I know," during discussion? Occasionally a child will know the word *evaporates* and use it correctly. Then other children may begin to "catch on" and use it too.

Some boys and girls may show progress in the way they begin to see relationships and adjust to the pattern of change. For instance, they may notice that it takes a long time for water to change form and disappear from a certain place, or that some things dry more quickly than others. Occasionally children may express ideas about how fast water goes into the air when in a sunny place or when heated on the stove. If so, they indicate that they are building ideas concerning energy and change.

Evaluation may go on continuously as a teacher works with children. During a discussion boys and girls may show that they are developing skill in speculating or making proposals. Some children may begin to

suggest that they test their proposals by experimenting or by talking with someone who may know, rather than just accept ideas. In order to think through what has been accomplished and what needs to be done, such questions as the following might be discussed by members of the group: What have we learned about water disappearing? What might we do to find out more about water going into the air? What changes should we make in our experiment? The results of such a discussion might be helpful to the group in planning for additional activities.

Bibliography

For the Teacher

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 183–184. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 437–439. Ginn and Company, 1958.

II

Animal Homes

The chapter about animal homes treats a very significant aspect of a child's environment. Animals living around children survive in various ways. One way which may be apparent to boys and girls is that of building homes or, in some cases, appropriating places suitable to use as homes. In order to help children develop a working picture of this idea, a variety of animals and their homes are introduced in the chapter. Animals have been selected which will give children an opportunity to gain ideas about variation in animal homes, including the variety of materials used, where the homes are built, and how they benefit the animals.

Some of these animals, like beavers, construct large homes. On the other hand, many animals, like wasps, spiders, and ants, build small homes. When making comparisons, perhaps children will observe that animal homes are constructed of many different materials. Some homes are very strong, while others are frail and loosely put together. Some animals, like foxes, do not build a structure. Instead they find a suitable place in a hollow log or a den among rocks which they occupy. Boys and girls may learn also that a number of animals have homes where they live for long periods of time. Possibly, as children refer to other animals which are not mentioned in the chapter they may find that some animals do not have any homes at all.

When exploring children's experiences and the material in the book, ideas may be gained about many different places where animals have their homes. Sometimes they are located in trees, bushes, or in the grass. Some may be found in hollow logs and rocky places. Other animals have their homes in water, in the ground, or around buildings.

Besides learning about the variation in kinds of animal homes, materials used, and where they may be found, children also need to find out how an animal is benefited by having a certain type of home.

In general, animals use their homes while caring for the young. Many adult animals leave the home as soon as the young can care for themselves. Some homes, such as a spider web, make it possible for an animal to secure food. Others offer an animal protection against enemies and the weather. Young children need not know all the details about the animals shown in the chapter. However, it is important that they gain ideas about how these animals, as well as others, are adapted to build or find good homes for themselves.

While using the book, there will be many opportunities to help children enlarge their concepts of animals. Many boys and girls as well as some adults limit the word *animals* to mammals. Birds are animals, insects are animals, and so are fish, frogs, snakes, dogs, horses, and bears. The smallest of all animals are so tiny that many hundreds of them live in a small drop of water. Every living thing which is not a plant is an animal. One purpose of introducing several different kinds of animals in the book is to help young children extend their concept of animals as suggested above.

The chapter may be introduced to develop an awareness of animals which live around your school and the children's homes and in the neighborhood. On the other hand, it might be used with children as a follow-up of some experience they have had on a walk with you, or observations they have made on the way to and from school, or experiences they have had at home. The children may have seen a film which created an interest in animals and a need to gain information from the book. A teacher may stimulate many situations which can lead children to use this chapter in developing concepts about living things.

Science Meanings for Children

Through numerous experiences children develop the following meanings as they learn how certain animals are adapted to build homes or, in some cases, are able to locate suitable ones:

Some animals make homes.
There are many kinds of animal homes.

Gradually ideas may be developed concerning the relationship of an animal to its particular type of home. Thus children come to see interrelationships, such as how the home is used while rearing the young, the way it offers protection against weather conditions or enemies of the animal, and how some homes make it possible for animals to secure food. Besides these learnings which involve adaptations of animals as well as interrelationships, it is also possible for children to enlarge their concepts concerning the variation in living things. There is much variety in animal homes in regard to places they are located, ways they are constructed, and protection they give. The variety often makes it possible for animals to survive. These large science patterns[1] of adaptation, interrelationships, and variety will be explored further in the next section.

Information for the Teacher

Before most children enter school they have various contacts with animals. Boys and girls living in a rural area may have numerous opportunities to learn about them. In contrast, the experiences of children living in a large city may be exceedingly limited in this respect.

A very young child's concern for animals may start with the family pet or that of a neighbor. Later he may come to know other domestic animals, and if wild ones frequent his environment he may become acquainted with them, too. As a result of his experiences, the four- or five-year-old may make interpretations about the way people offer protection for animals, such as by providing a doghouse, a barn, or even the family home. Occasionally children see birds building nests, spiders spinning webs, ants making a hill, or discover animal holes in the ground. From such observations boys and girls may develop the beginnings of ideas relating to the ways animals manage to survive.

If your group of children live in a neighborhood where there are yards around their houses, they may have many opportunities to see animals living there. A few of these animals may build homes, others may just take over a place suitable to their needs for a short period. Still other animals may frequent the yard but never make a home anywhere. If numerous trees and bushes provide protection, there may be various kinds of nests during nesting time. The boys and girls might see holes in the ground indicating an underground burrow of a woodchuck or other burrowing animal. Possibly they will find spider webs or locate an anthill in the yard.

The park is another place where some children see homes of animals.

[1]For a further discussion of these large patterns, see the Foreword, pp. xx–xxiv.

Possibly a gray squirrel will be observed. He may have a large nest on a high branch, or it may be in the hole of a tree. If the park is in an area where chipmunks are found, they may be seen inhabiting a hole where a woodpecker used to have its nest or they may be living in some other similar place. Perhaps children will see nests in trees and bushes or around park buildings. Here, too, they may find wasp nests, underground burrows, and other kinds of homes.

Some children in your group may live in a rural area. A child who has watched English sparrows carry straw and feathers to build a nest in a barn will have information to contribute. Another child may have seen the muddy nest of a barn swallow under the eaves. Possibly someone will spontaneously tell how he found a nest of young mice as he was playing in a barn. A number of children may have observed birds' nests on the ground in a field or in trees and bushes around their houses. While walking in a pasture some individual may have noticed several small holes in the ground or observed an animal run into its hole.

When boys and girls go to the woods, meadow, stream, lake, or beach along the ocean, there are many opportunities for them to observe animals. A flicker may fly to its round hole in a tree. A startled ground squirrel might dart into the ground for safety. Paper wasps may fly in and out of their large gray conical nest fastened to a branch. Perhaps a frog will be seen swimming in the pond. Several crabs may be crawling around in a tide pool where children can watch them. Some of the animals which children observe in these habitats (a habitat is a place where an animal is commonly found) will have homes and others will not. As a result, comparisons may be made and thinking stimulated about how animals manage to survive, especially when they do not have a home.

In the following material for the teacher, information is provided about the animals and their homes illustrated in the chapter. Some of them may not be found in the particular environment where you live. In that case, there will doubtless be others that the children have seen which they will want to consider. The information given here may be helpful background for guiding children to see the great variety of animal homes in their own environment. Also this material offers direction for the teacher in helping children learn more about how animals benefit from their homes. It is suggested that many animals living in your neighborhood be considered when developing the science meanings introduced in *Science Near You.*

Beaver House · Beavers build houses in ponds or lakes. They gnaw around willow, cottonwood, or aspen trees until they fall. Then with their sharp teeth beavers chip the branches off and cut the logs into

short lengths for use in building the house. These are pulled together in the water and securely fastened with mud, which the beavers get by diving to the bottom of the pond, and bringing up a load held between their forepaws and chin. The mud is unloaded on the sticks and logs of the house. Beavers are excellent swimmers and capable of pulling large branches through the water to the home. Sometimes instead of building houses, beavers make nests in burrows in the banks of streams.

Beavers need a home where they can care for their young. The house also serves as protection against weather and enemies. In the winter beavers stay in the house most of the time. It is possible for them to secure food when the pond or lake freezes because of the way the house is constructed. They go out of the house through an exit below the surface of the water and secure green twigs which were stored in the mud during the autumn.

Nest of the Great Blue Heron · A nest of the great blue heron is large and made of sticks. Usually it is found at a great height in trees along marshes, streams, and lakes. A nest offers protection for rearing the young.

Nest of Gray Squirrels · Gray squirrels build nests on high branches, usually more than twenty feet from the ground. They are made of sticks, finely shredded bark, and leaves. The illustration at the top of page 11 in *Science Near You* is of a western gray squirrel and its nest in an oak tree. Eastern and western gray squirrels are very similar in appearance. The eastern squirrel also makes a large leafy nest similar to the one pictured. Sometimes cavities in trees serve as homes for squirrels. The nest offers protection from weather and enemies and provides a place for rearing the young.

Home of Red Foxes · Red foxes use large hollow logs or places among rocks for homes. Sometimes they dig holes in a hillside. The home provides protection from weather and enemies and serves as a place to care for the young.

Nest of Paper Wasps · Paper wasps also build structures which offer protection. The wasps moisten and chew bits of wood to form a paste. They use this to build large gray conical nests fastened to branches of trees or bushes. The outside of the nest is made of many layers of the paste. Inside, several stories of combs are fastened together. The cells in these combs, which are made of the paste, are for the young wasps. The entrance is at the bottom of the nest. The many other kinds of wasps build a wide variety of nests.

Home of Black Harvester Ants · There are many kinds of ants and they too build a variety of nests. The hill of the black harvester ant is shown at the bottom of page 12 in *Science Near You*. If the hills

these ants build are close together, they may belong to the same colony of ants and be connected by underground tunnels. When making the tunnels and underground galleries of the nest, ants carry grains of sand and other material with their jaws. The sand is taken out of the nest and, as a result, a mound is built. Usually there are several openings in a hill. The young are cared for in the galleries, and food which is not eaten by the workers is stored elsewhere in the nest. Protection from enemies is furnished also by the nest.

On page 12 in *Science Near You,* two ants are shown carrying pupae. Young ants emerge from these pupal skins, which are parchmentlike sacs. A pupa is about the size of a small wheat seed.

Web of Golden-Banded Garden Spider · When spiders start to make a web, they spin a thread of silk while swinging from a high place. The thread touches something and sticks to it. Then other lines are stretched to form a silken framework which is fastened by guy lines to various objects. The spokes of the web are attached to the silken framework and then connected together at the center. By starting at the edge of the web, spiders spin a continuous, sticky, elastic thread from one spoke to another, going around and around until they reach the center of the web. The white part of the web shown in the illustration at the top of page 13 in *Science Near You* indicates how the center is strengthened. The spokes on which the spiders walk are not sticky or elastic.

The web is usually in a vertical position so that it will be in the path of insects. As they touch the sticky part of the web the insects become entangled and are caught by the spider. Therefore, the home is useful to this animal in securing food.

Nest of House Mouse · There are different kinds of mice and each has its own particular type of home. House mice live in barns as well as in houses. Sometimes they live in fields. They make their nests of pieces of cloth, paper, grass, or other soft material. The nest is used while caring for the young mice.

Nests of Birds · There is great variation in the places where birds build nests, the kinds of materials they use, and the types of nests. Some birds build elaborate nests, and their young spend considerable time in them because they mature slowly. In other cases, the birds make almost no nest. Their young develop within a comparatively short time. Generally nests are built according to the type of young birds which will occupy them.

Some nests can be seen high in trees, and others in low bushes or tall grass. Many birds make nests in hollow trees, cliffs, rocky places, buildings, and sometimes in birdhouses.

A variety of materials is used in nest building. The kind of material

depends on what is available and the location of the nest. One nest might be made of small twigs, feathers, leaves, rootlets, hair, and string. Another might contain sticks, rootlets, and hair, which have been cemented together with sticky mud. An oriole makes a very complex nest of grasses or other fine material. A kingfisher digs a horizontal burrow in a steep sandy bank near water and lays its eggs in the nest, which is built at the end of the four- to eight-foot-long burrow.

The size and shape of birds' nests also vary. An eagle's nest is a huge structure of sticks found on high ledges or in trees. In contrast, hummingbirds' nests usually do not exceed an inch in diameter at the top. They are delicately fashioned of lichens and cobwebs.

Usually the nest serves only as a home for young birds. As soon as they are able to fly and care for themselves they leave it. With some birds a home may be little more than a roost somewhere.

Barn swallows, eastern song sparrows, red-winged blackbirds, and robins, and their nests are illustrated on page 14 in *Science Near You*. Barn swallows build nests of mud mixed with straw and feathers. These are fastened under eaves, on beams of buildings, under bridges, or in niches of caves. The nests of eastern song sparrows are constructed in low bushes or tall grass. They are made of rootlets and grasses and then lined with fine grass and hair. The nests are usually over two inches in diameter at the top. Red-winged blackbirds fashion nests of dried grasses in bushes near water. Many times they are located in cattails or tules. Robins build bulky nests of twigs and grasses cemented together with a considerable amount of mud. They are fastened to sturdy branches or sometimes to buildings.

Ways of Working with Children

When introducing the chapter "Animal Homes," it may be helpful to start with the children's ideas about animals in general. Encourage contributions about their dogs, cats, or other pets. Some children may tell about cows, pigs, chickens, or rabbits they have at home or have seen on a farm. Through discussion it may be brought out that people provide shelter for animals in their houses and barns or by building doghouses, pens, and cages. Thinking can be stimulated about the ways animals benefit from these shelters as they receive protection against weather and enemies, and have a place to care for the young. Some children may tell about other animals living around their homes, such as birds, snakes, lizards, mice, caterpillars, ants, or spiders. As these animals are discussed considerable emphasis might be given to whether they have homes and if not how they manage to live.

Some child's home might be visited for the purpose of learning where animals, such as rabbits, chickens, puppies, or cows, are kept. When planning for the walk, guide the children in thinking through what they want to find out about the animals, especially in relation to their homes. They may be able to see homes of animals along the way. After this trip some children may paint pictures of the animals they observed and the home which was provided. Through discussing what they saw on the walk, many ideas may evolve concerning the needs of animals and how they are met.

From the classroom windows it may be possible to observe an animal's home which people have provided. Possibly a home built by an animal, such as a bird's nest, can also be seen. While looking out the windows the children may speculate as to what animals might build homes in the area they can see.

By talking about many animals known to the children, the fact will be brought out that some animals build homes, and that others do not. In some cases, instead of making homes, animals live with people in their houses or in homes which have been provided by people for them. Children may compare different kinds of animals and their homes. There will be many opportunities to develop concepts in the direction of a large idea, such as that animal homes are a means of adaptation. Variation may be noted in relation to how and where animals live and ways in which they are protected. The animal's relationship to its home and other aspects of the environment can be emphasized.

Pages 10–15 · Animal Homes

Some animals make homes.

Page 10 · When talking about the herons and beavers shown on this page, ideas about their homes might be developed. The heron's nest is made of sticks and is in a tree. It is very different from the beaver's house, which is built in the water and made of logs, sticks, and mud. Children might discuss why herons and beavers have homes. Bring out the fact that they need a place to care for their young. The beaver house also provides protection against enemies and weather conditions. If the pond or lake is frozen over, a beaver can go out of the house through the underwater exit and secure green branches which he stored in the mud during the fall. In order to help children see how beavers work to build their houses, lead them to notice how the beaver is cutting down the tree and how the swimming beaver is carrying a branch toward the house.

Some animals make homes.

Page 11 · Many children may have observed a gray squirrel similar

to the one shown here. What did they see the squirrel do? Where did he live? Did they see his home? The gray squirrel in the illustration has a home on a high branch. It is built of sticks, finely shredded bark, and leaves. Guide the children in discussing why the squirrel needs a home. Bring out the fact that the animal needs a protected place high in the tree away from its enemies so the young squirrels may not be harmed. Prompt the boys and girls to discuss how they think the squirrel might have built the nest and what materials were used for it.

Your environment may offer opportunities to learn more about a squirrel's nest. If gray squirrels live nearby, take the children for a walk so that they can make observations and possibly find out about this kind of home. The squirrels you observe may have their homes in the cavity of a tree instead of building the nest on a branch. It will be necessary to plan thoroughly with children before taking the walk in order for them to have a profitable experience. If it is not advisable to take a walk, possibly squirrels can be seen from the classroom windows.

When discussing the home of the foxes in the illustration, observe the wooded area where the foxes live and the rotted log which offers them protection. Sometimes these animals find a secluded place among rocks rather than use the cavity of a log as illustrated. Ask the children what makes this a good home for a fox. Prompt the group to compare this type of home with the others shown on pages 10 and 11. Do they know of any other animals which make homes in hollow logs?

If these animals live in your locality, this information may have come out in the discussion. However, even though red foxes live there, boys and girls may not have seen them. What other animals do they see in their environment? Where are their homes and how are they used? How do the children think the homes of these animals help them?

Some animals make homes.

Page 12 · Some children may have seen a wasp's nest as shown here. If possible, try to obtain one at a museum or from some other source in the community. It will be helpful for the children to observe a nest close at hand, and they probably will not be able to find an uninhabited one outdoors. What spontaneous comments do the children make about this kind of home? Some of the children may be interested in comparing this home with those which they have observed or which have been discussed previously. Ideas can be developed as to why wasps need the nest. At this point, information should be offered about how wasps build their nests and how they care for the young wasps. Some children may not think of wasps as animals. This may be a good opportunity to broaden children's concepts concerning the meaning of *animal*. Help

the children to understand that every living thing which is not a plant is an animal.

Encourage boys and girls to tell about anthills they have seen in the back yard, a vacant lot, or other places. You might ask: What did the hill look like and what were the ants doing? As the children look at the anthill on this page lead them to compare this one with ant nests they have seen. The following questions might be discussed: What are the ants doing? How are they carrying the pupal cases which have young ants developing inside? Where do the ants go into the hill? Why do the ants need a home? Information can be shared about the way ants care for the young in the nest and the way food is stored. Many ideas might be presented illustrating how the nest serves as a protection for the ants.

Some children might plan to look for anthills around their homes and observe the ants going in and out. What questions are asked after such experiences? What interpretations are children making as they gain more information? At this point, it might be advisable to take the group for a walk to see an anthill. Sometimes the children may observe ants around a hill after a rain. Possibly a child has seen ants carrying eggs or pupae as they move away from their nest. Sometime you might wish to read to the children parts from a book about ants to offer more information or verify a child's ideas.

There are many kinds of animal homes.

Page 13 · Even though young children have seen spider webs, they may not have observed spiders actually spinning. Information about the way a web is constructed will be helpful in finding out about a spider's home. Sometime it may be possible to observe a spider spinning a web. Provide a magnifying glass so that the children can observe details. Ask them to note where the spider fastens the web. If an insect is caught, watch how the web is used.

In what kinds of places have the boys and girls seen spider webs? Have they noticed how webs differ in appearance? If a child has touched a web, he might tell how it felt. Through discussion ideas can be brought out about a spider's need for a home and the way he uses it. This kind of home might be compared with other homes shown in the chapter as to location, material, and the way it serves the animal. Learnings about a spider's home as well as homes of other animals may be directed toward the large idea concerning the adaptations of animals to provide protection and care for the young.

Mice also make nests. There are many kinds of mice which can be observed in various places other than in the barn, as shown. Some

children may tell about nests they have seen and refer to the kinds of materials used. The children might suggest ideas about how they think mice benefit from building nests. Possibly some boys and girls have seen very young mice and can tell how they think the soft nest helped the little animals. In order to learn more about mice, some of the boys and girls could plan to talk with someone at school or at home who has the information.

In order to summarize their ideas about these small animals, the group might look at all the homes shown on pages 12 and 13. Their ideas might be recorded on a chart to be read and referred to by the group at different times. A child's painting relating to this content might be placed on the chart. As a result of summarizing, children might begin to draw some generalizations regarding these homes and come to realize that animals make many different kinds of homes.

There are many kinds of animal homes.

Page 14 · When talking about the birds and their homes which are shown in the book, attention might be focused on the location of the nests, their shapes, the materials used for them, and the ways they are built. What spontaneous comments are made about why the nests are different and why they are constructed in various places?

As the boys and girls tell about birds' nests they have observed in the neighborhood ideas may emerge pertaining to the variety in sizes and shapes of nests as well as in the materials which were used in building them. Perhaps several children may tell about birds they have seen carrying materials to nests. Nest building might be observed from the classroom windows. During nesting season the boys and girls might hang string and yarn on a bush near the windows and watch to see if a bird will use them. Out of such experiences may come ideas about how birds are able to survive.

Walks might be taken to see birds' nests during the nesting period and, if possible, to watch the birds building them. Observe the location of nests in order to gain the idea that birds build nests in many places. Notice the variation in the shape, size, and material in nests. When taking walks, develop a feeling of responsibility for the environment so that children will be ready to leave nests where they are even though there may be no birds or eggs in them. Many times birds return to nests, reline them, and raise another brood. Help the children to see the importance of observing a nest from a distance so that they do not disturb the birds.

Page 15. Which Animals May Have Homes Here? This page may be used to help children summarize their learnings and apply them to

a new situation. The chapter has introduced homes of animals which can be found on the ground, in trees, bushes, fields, in water, and also in or near buildings. After boys and girls have considered the question at the top of the page, they might look at all the pictures in the chapter and decide where each animal could live in the situation illustrated on page 15. A similar summary might be made by looking out the classroom windows and speculating as to which kinds of animals might be able to live in that type of environment. As you listen to the children's comments what clues do you receive about their ideas? Are they utilizing the facts gained from their observations, films, discussions, and other activities? What attitudes are being developed concerning animals?

After reading the text on the page, you might encourage the children to paint pictures in answering the question, "Where have you seen animal homes?" When the paintings are mounted and arranged on the bulletin board, each child might tell about his work. This can serve as another summarizing experience for this chapter.

Materials Needed

For use with *Science Near You*:

calcimine paints magnifying glass newsprint, 18″ × 24″

For use with Further Experiences:

paper for booklets

Further Experiences

Viewing Films · The experiences of boys and girls might be extended by looking at films, such as *Gray Squirrel, Animal Homes,* and *Five Colorful Birds.* (See list of films at end of chapter.) If you preview the films you will be better prepared to guide the children's observations effectively. After the children have seen a film, their ideas need to be discussed and time given for questions. It may be advisable to show a film more than once to help children find answers to their questions and clarify some of their concepts.

Gaining Information from Books · To offer more information, selections might be read to the group from a book such as *Let's Go Outdoors* by Harriet E. Huntington. Material about ants can be found on pages 30–37 and information concerning spiders on pages 44–49. This book and others are listed in the bibliography at the end of this chapter.

Summarizing in Charts and Booklets · From time to time it may be appropriate to record on charts for children's later reference some of the summaries they make concerning animal homes. Sometimes the purposes for taking a walk may also be recorded so that children can refer

to them after returning and discuss information gained about each item. Booklets about the homes of animals may be made to include ideas children have developed.

Alhambra City School District, Alhambra, California

Books are a source of information as well as pleasure.

Evaluation

When evaluating progress in relation to children's changing behavior, it might be a good idea to bear in mind that concepts are seldom, if ever, created in the child's mind during a brief period. It takes time for real concept formation. Therefore, a child may need several experiences to allow time for thinking, for internalizing an idea, and for making it his own.[1] Sometimes when the group is discussing impressions or observations made on a walk, or during some other experience, a child may not express himself at first. However, a week later he may venture forth with a contribution showing that he gained much information and that it was a helpful experience.

While analyzing spontaneous behavior clues may be gained concerning the progress children are making and their needs for additional

[1]John G. Navarra, *The Development of Scientific Concepts in a Young Child: A Case Study* (New York, Bureau of Publications, Teachers College, 1955).

experiences. In what way are they expressing more interest in animals and becoming more aware of the animals living around them? Which children question why some of these animals do not have homes or how others build homes? Are some individuals showing evidence of planned behavior instead of impulsive actions such as squeezing, dropping, or pulling the tail of an animal? What evidence is there that children are rejecting personification of animals? Which children are becoming critical of fiction stories about animals?

There will be opportunities to evaluate concept formation as children share their experiences with the group, discuss information they find in the chapter, and apply what they have learned to new situations. What ideas are they gaining concerning the relationship of an animal to its particular type of home? What comments are made about how some animals benefit from having a certain type of home? Which individuals are coming to realize that many animals are adapted to build homes or are able to appropriate suitable ones? In what way are concepts being extended concerning the variation in kinds of animal homes? By developing such concepts members of the group may become more resourceful and better able to make a more intelligent adjustment to their environment than they did previously. From such evaluation, ideas may be gained about further experiences which should be offered to the group.

Bibliography

For the Teacher

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 272–276. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 557–579. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition. Wm. C. Brown Company, 1955.

For the Children

Baldwin, Victor and Jeanne. *Little Kitten, Big World.* William Morrow and Company, Inc., 1956. Story of a day in the life of a kitten told through excellent photographs and a small amount of text.

Blough, Glenn O. *Who Lives in This House?* Whittlesey House (McGraw-Hill Book Company, Inc.), 1957. A well-told story and attractive format give information about homes of animals such as those of robins, squirrels, bees, and spiders.

Earle, Olive L. *Robins in the Garden.* William Morrow and Company, Inc., 1953. Life history of a family of robins, illustrated with black and white drawings.

Hawkinson, Lucy O. and John. *City Birds.* Albert Whitman & Company, 1957. Attractive illustrations and a small amount of text give information about city birds in their natural surroundings.

Huntington, Harriet E. *Let's Go to the Brook.* Doubleday & Company, Inc., 1952.

Huntington, Harriet E. *Let's Go to the Desert.* Doubleday & Company, Inc., 1949.

Huntington, Harriet E. *Let's Go Outdoors.* Doubleday & Company, Inc., 1939.
Huntington, Harriet E. *Let's Go to the Seashore.* Doubleday & Company, Inc., 1941. Excellent photographs and simple text describe animals and their habitats.
Kane, Henry B. *Wild World Tales: The Tale of the Mouse, the Moth, and the Crow.* Alfred A. Knopf, Inc., 1949. Excellent photographs illustrate the informative account of the life of a white-footed mouse.
McClung, Robert M. *Stripe: The Story of a Chipmunk.* William Morrow and Company, Inc., 1951. Attractive format and many pictures add to well-told story about the life history of a chipmunk.
Meeks, Esther K. *In John's Back Yard.* Follett Publishing Company, 1957. An easy-to-read book with appeal for young children, which might stimulate curiosity and develop an awareness of what is nearby.
Morgan, Alfred. *Pet Book for Boys and Girls.* Charles Scribner's Sons, 1949. Written for older children but suggested as a reference for teachers to help young children find out how to care for pets.
Schwartz, Charles. *Cottontail Rabbit.* Holiday House, 1957. An informative story about a cottontail rabbit, its habits of feeding, playing, mating, making a nest, bearing young and nursing them.
Webb, Addison. *Birds in Their Homes.* Garden City Books, 1947. Colored and black and white illustrations of over fifty varieties of birds supplement the text in describing how birds live, build their homes, and care for the young.
Weil, Ann. *Animal Families,* Revised Edition. Childrens Press, 1956. Simple text and pictures in color depict parents and offspring of various families of animals. This is a revision of the 1946 edition of this book.
Witty, Paul, and others. *Farm Animals.* D. C. Heath and Company, 1950. Photographs and simply written text present brief information about kinds of farm animals, their characteristics and habits, and the care given them by the farmer. Booklet based on film of same title produced and distributed by Encyclopaedia Britannica Films, Inc.
Witty, Paul, and others. *Gray Squirrel.* D. C. Heath and Company, 1950. Simple narrative text and photographs describe gray squirrels, their habits, home, and food. Booklet based on film of same title produced and distributed by Encyclopaedia Britannica Films, Inc.
Zim, Herbert S. *Goldfish.* William Morrow and Company, Inc., 1947. A well-illustrated guide for teachers to use while working with children in setting up an aquarium for goldfish and learning how to care for them.
Zim, Herbert S. *Rabbits.* William Morrow and Company, Inc., 1948. Gives much information about rabbits and clear directions concerning housing and care of them. Written for older boys and girls but parts might be used with young children.

Films

ADVENTURES OF BUNNY RABBIT. (EBF) 1 reel, b/w. Illustrates characteristics of mother cottontail rabbit and young in their natural habitat.
ANIMAL HOMES. (C-W) 1 reel, color and b/w. A variety of animals with their homes illustrate variation in kinds of homes, variety of materials used, where homes may be built, and how homes benefit the animals. Shown are red-winged blackbirds, ants, spiders, gallfly, mole, gopher, possum, and coatimundi.
ANIMAL HOMES. (EBF) 1 reel, b/w. Shows where animals live: in trees, in the ground, and in water. Includes such homes as those of the trap-door spider, squirrel, skunk, raccoon, woodchuck, and wood mouse.

ANIMALS GROWING UP. (EBF) 1 reel, b/w. Shows parental care and development of a young calf and a litter of puppies.

BIRDS IN YOUR BACKYARD. (Barr) 1 reel, color. Suggests ways of encouraging birds to come to the yard; includes observations made of the house finch, towhee, mockingbird, Chinese spotted dove, band-tailed pigeon, and several kinds of sparrows.

THE BLUEBIRD. (Heidenkamp) 1 reel, color. Focuses on nesting habits, parental care, and economic value of the bluebird.

CARE OF PETS. (EBF) 1 reel, b/w. Shows how to care for pets, such as fish, a canary, cat, and puppy.

COMMON ANIMALS OF THE WOODS. (EBF) 1 reel, b/w. Pictures where some animals live and the habits and characteristics of the squirrel, raccoon, porcupine, mink, beaver, opossum, skunk, and woodchuck.

FARM ANIMALS. (EBF) 1 reel, b/w. Attention focused on way farmer cares for his animals and their value to him.

FIVE COLORFUL BIRDS. (Cor) 1 reel, color. Depicts habitat, feeding, nesting, and rearing of young goldfinch, cedar waxwing, yellow-headed blackbird, red-headed woodpecker, and bluebird.

GRAY SQUIRREL. (EBF) 1 reel, b/w. Shows activities of three young squirrels and the mother.

NO VACANCY. (Holst) 1 reel, color. A hermit crab finds a shell for a home.

PIG TALES. (Frith) 1 reel, color. Tells how pigs are raised on a modern farm, kind of parental care they receive, and how young develop.

RED HEN. (Barr) 1 reel, color. Describes the way a hen lays eggs and incubates them, then cares for chicks after they hatch.

SHEP—THE FARM DOG. (EBF) 1 reel, b/w. Shows activities of a collie throughout the day on a farm.

THREE LITTLE BRUINS IN THE WOODS. (UW) 1 reel, b/w. Pictures animals living in the same habitat including bear, fox, tortoise, woodchuck, skunk, raccoon, deer, otter, muskrat, and owl.

WILD ANIMALS, THEIR HOMES AND HABITS. (Barr) 1 reel, b/w. Shows the homes of various animals and also how they protect their young.

Filmstrips

ANIMAL HOMES. (CurrF) 6 filmstrips, color: NESTS, CAVES, BURROWS, HOLLOW TREES, LODGES, INSECT COMMUNITIES.

ANIMALS OF THE POND. (CurrF) color.

HOMES OF BIRDS. (SVE) color.

III

Young Animals

Most children have had experiences with young animals and therefore will have some background for this study of them. There may be many opportunities to broaden and extend their concepts, especially concerning parental care. For those boys and girls who have not had an opportunity to be with young animals, *Science Near You* may help to develop an awareness of the needs of young animals and the part of the parents in caring for them. Variation in parental care is pointed up through discussion of different kinds of animals. Several of these give their offspring much care. In contrast, the young of some animals must look after themselves from the very beginning.

The mammals and birds illustrated in the book give considerable attention to their young. For example, a horse provides protection for her colt and nurses it for several months. A bear looks after her cubs for an extended period. Young lambs nurse their mothers and receive much attention from them. Other examples are given in the pictures showing a cat licking a kitten, and the way she carries a kitten to a new place of safety. Birds, such as mallard ducks, offer parental care in different ways, as illustrated on page 19 of *Science Near You*.

When considering these birds and mammals, as well as similar animals referred to by the children, ideas may be gained about variation in the amount of care given by the parents, the length of time the young stay with them, and the varying maturity of different animals when first born or hatched. Of significance for children is the fact that some animals have only a few offspring and that the young of these animals require considerable attention.

As boys and girls become concerned about a wider variety of young animals they may find that many of them are not cared for by their parents. To bring out this idea, some of these young animals are illustrated in the book. The offspring of grasshoppers, snails, toads, frogs, turtles, and fish are able to look after themselves because the females lay their eggs in a suitable environment. As a result, when

the young hatch from the eggs, they are able to secure the proper kind of food and have some protection among plants without the presence of the parent. Even then, of the many eggs laid, relatively few hatch and mature to adulthood owing to numerous hazards.

Because animals form a significant aspect of a child's environment, adults may well consider the kind of interpretations being made of them. We, as teachers, are concerned with the attitudes boys and girls develop toward other living things. We are also concerned with children's recognition that they themselves are part of a great web of life and that other living things have an important place in this web. We, as human beings, are dependent upon many other kinds of living things. Therefore, a child should begin to develop ideas about animals which are in keeping with the best understanding men have of the living world. It is not necessary nor desirable for children to learn all the details about the animals shown in *Science Near You*. Instead, emphasis needs to be given to the ways animals are adapted to survive and continue reproducing their particular kind of life.

Science Meanings for Children

The following science meanings are developed in the chapter:

Some young animals need care.
Some young animals do not need care.

The purpose of the material presented in *Science Near You* is to help young children gain ideas involving these meanings which will guide their thinking toward large ideas about parental care of young animals. Through many experiences, boys and girls may gradually come to see that some animals care for their young, while others give the offspring no attention. Also, insight may be gained concerning the ways animals are adapted for survival, thus continuing the various kinds, or species. You may find it helpful at this time to reread pages xx–xxiii of the Foreword which discuss more fully the patterns of adaptation and variety.

Information for the Teacher

Very young children sometimes have opportunities to learn how animals care for their offspring. Even the two-year-old child

may have experiences with the puppies of the family dog or the kittens of the house cat. He may watch the dog guard her puppies or feed her young. Possibly he notices how the cat licks the kittens and keeps them near her. Through such observations he may begin to make interpretations concerning the needs of young animals.

If the four-year-old lives in a rural area, he may find out how a hen nestles over her brood to keep them warm, how a calf obtains milk from its mother, or how a duck takes her ducklings for a swim. He may wonder about the ways some animals care for their young and ask why, how, and when.

As the child matures he makes more observations and interpretations. Possibly he begins to notice more of the smaller animals than he did previously. He may want to know if grasshoppers are ever small, why a mother frog does not stay with the tadpoles, why young birds fly away from their mother, or why his goldfish eats the young fish instead of caring for them. Through such curiosity a child shows that he is trying to make interpretations about the young of animals he sees around him and to fit his ideas together concerning their need for parental care. On the other hand, it is possible that a child may not have wondered or asked such questions as these. However, he might be stimulated to do so by using *Science Near You,* discussing experiences, looking at films and filmstrips, taking walks, and in other ways.

If your group of boys and girls live in a large city, they will have different kinds of experiences with animals than six-year-olds who reside in a rural community. Some children in a city occasionally see birds carrying food to the young in nests or birdhouses. Someone in your group may observe a squirrel running to its nest where there are young. Another child may have noticed ants carrying eggs or pupae or have seen young spiders emerging from an egg sac. The city park or zoo offers opportunities for some children to become acquainted with various animals. Occasionally a few of the young may be observed there. Even though children live in a large city, some of them may have pets in their homes. Rarely, however, is there an opportunity to have firsthand experiences with young animals. As a result, it might be desirable for the school to assume the responsibility of providing situations for children to have firsthand contacts with parental care of young animals.

In order to guide the experiences of members of your group in relation to the animals shown in the book, you may wish to refer to the following content. This information might be helpful when considering the variation in ways animals do or do not care for their young. It points out adaptations by which animals survive and continue their kind.

For the purpose of enlarging children's concepts, great scope is given

to this subject by the introduction in the book of a number of animals which have wide geographical distribution. Also, to call attention to variations in the ways animals care for their young, a number of different kinds of animals are used, such as mammals, birds, reptiles, and insects. To be sure, children should be encouraged to draw upon their own experiences with young animals and not be limited to those illustrated in the book. You may live in a region where some animals shown in the text are not found. However, both you and the children will know some in your own neighborhood which can be used to illustrate adaptations similar to those of animals given in the book.

Many young animals which require parental care develop within the body of the female. At birth they are so helpless that they would not live long if they did not have care from an adult. Some are hairless, others are blind, but all of them are dependent on the parent for food and protection. On the other hand, many young animals receive no care from their parents. They usually hatch from eggs and are sufficiently developed to care for themselves. They survive if they can secure enough food, are not eaten, or do not become subject to disease. Potentially they have the capacity to reach maturity; however, most of them do not do so.

Ewe and Lamb · A ewe provides considerable care for her lamb throughout several months. A young lamb can stand up soon after it is born and nurse the mother. Besides feeding it, the mother offers protection while it plays near her or eats grass. Sometimes twin lambs are born, but rarely are more than two born at a time. A lamb is weaned after about four months.

Mare and Colt · A mare is another illustration of an animal which cares for her young a rather long time. A colt is very weak when it is born. At first, the mother helps the colt to stand so it can nurse. She takes it with her for a drink, runs with it, and guards it very closely. Usually one colt is born at a time. It is weaned when it is between four and six months old but continues to stay near the mother for a longer time.

Hen and Chicks · A hen sits on a setting of eggs for approximately twenty-one days. When they hatch, she helps the chicks find food and water. She clucks to her chicks to call them to her. By hovering over them, a hen provides protection and warmth. She watches them closely, signals when there is danger, and fights to protect them. The hen and chicks on page 17 of *Science Near You* are Rhode Island Reds.

Cat and Kittens · A mother cat gives her kittens much care. When they are first born they are very small, their eyes are closed, and their legs are weak. They stay close together in the bed she has made for

them. Here she nurses them and keeps them warm. In about eight or ten days their eyes are open and their legs are stout enough to walk. The mother carries them by holding the loose skin on the back of their necks. When they are older, she teaches them to hunt for mice and other food. A mother cat is very attentive to her small kittens and guards them closely. Usually there are several kittens in a litter. They are weaned when they are between six weeks and two months old.

Mallard Duck and Ducklings · A mallard duck makes a nest on the ground among grasses near a pond or lake. She lays approximately eight to twelve eggs and sits on them for about twenty-six days. When the young ducklings are hatched she helps them find food, takes them into the water to swim, and hovers over them to provide warmth and protection. She guards her young closely and fights for their protection against enemies. They stay with her for several weeks. The drake guards the nest occasionally but takes no part in caring for the ducklings.

Black Bear and Cubs · A mother bear provides much care for her young and over an unusually long time. Newborn black bear cubs are very small and undeveloped. They are born during the winter and remain in the den with their mother for about three months. She nurses the cubs and later helps them to find other food, such as roots, nuts, fruits, grasses, fish, insects, and small rodents. In time of danger a mother drives the young up a tree where they must stay until she signals them to come down. The cubs go into a den with the mother in the fall and stay with her until the next spring. After that, she forces them to care for themselves. A mother bear offers much protection and is a ferocious fighter. Usually a bear has two cubs at a time. Occasionally she may have three but rarely four cubs. "Black" bears vary in color from a light brown to nearly solid black.

Young Grasshoppers · Young grasshoppers look much like adult grasshoppers except that they have no wings and are much smaller. The parents do not take care of them. The female lays eggs in holes in the ground near plants. As soon as the young hatch they feed on the plants and care for themselves. As they do so they grow larger, shed their skins, and develop wings. Most grasshoppers shed their skins about five times. These insects illustrate how various animals lay many eggs and then leave them to hatch. By chance, some hatch and a fewer number live to maturity.

Young Land Snails · A female snail lays small white eggs in moist places among plants. Some hatch and some do not, with no attention being given to the young by the parent. The young snails feed on leaves and care for themselves. Survival of kind is dependent upon the laying of many eggs. By chance, some snails hatch and reach maturity.

Tadpoles · Frogs and toads lay their eggs in water during the spring. Frog eggs are laid in a clump of gelatinous material, and toad eggs in gelatinous strings. After the eggs are laid, the adults give no more attention to them. The young tadpoles, or polliwogs, hatch and care for themselves. Later they become frogs or toads. The continued existence of frogs and toads is dependent on the great number of eggs which are laid.

Young Turtles · A turtle lays eggs in a sandy place on the bank of a stream or pond. She makes a hole in the sand and lays several white soft-shelled eggs in it. Then she covers the eggs with sand and goes away. After several weeks some of the turtles hatch and go directly into the water, where they care for themselves. Occasionally they leave the water for a short period of time. The mother turtle provides no care for her offspring. They secure food, such as insect larvae, earthworms, and plants. Young spotted turtles are illustrated on page 22 in the children's book.

Fish · Most fish lay eggs, but a few bear their young, including the familiar aquarium fish, the guppy. Some fish lay many eggs at one time; others lay only a few. Young fish eat very small water animals as well as water plants. Practically all young fish must care for themselves. There are a few exceptions, such as the stickleback and sea horse, which give special care to their offspring. Young of the common mackerel are shown on page 22 of the children's book.

Ways of Working with Children

Science Near You might be used to introduce children to the study of animals and to develop a concern for the way they live. On the other hand, it might be introduced as a result of experiences which the children have had with their pets at home or at school. Or it can be used after questions have been raised about young animals seen on a trip to a farm or a park or on a walk in the neighborhood. The chapter could serve to extend ideas brought out by a story about parental care which has been read to the group. Children are usually very interested in animals and therefore their concerns may offer pertinent leads for the use of this section of the book.

Encourage boys and girls to talk about young animals they have seen. Some children may have pets which have young. Kittens, puppies, or baby birds may have been observed in the neighborhood. Some child may have seen young spiders. Someone else may have seen young fish or snails. If they live in a rural area, the boys and girls might have information to offer about calves, lambs, pigs, colts, chicks, ducklings, or young

turkeys. The following questions might be discussed: What have you seen the animals doing? Where was the mother? How did she care for her young? Why did they need her? Which animals did not need the mother?

By talking about animals which are familiar to the children, some ideas may be gained about ways in which several of them care for their young. The boys and girls may find out that some animals around their homes and school do not look after their young. In addition, some insight may be gained concerning variations among these animals, the relationship between parent and young, and their relation to other phases of the environment.

We Want to Know	How to Find Out
How do some birds teach the babies to fly? Does a spider care for its babies? How does a dog care for its puppies? Why don't fish care for the little fish?	Look at young animals. Look for mother animals. Find pictures. Find books about animals. Ask people.

Through children's spontaneous responses you may gain clues to the experiences they have had with young animals, where individual children are in their thinking, and the kinds of interpretations they are making. As a result, many general questions about young animals may arise which offer direction for securing more information. After they have been helped to state their questions about animals, boys and girls may develop some skill in learning how to solve problems as they try to find satisfactory answers. It may be appropriate to write on the board their questions as well as their suggestions for finding the answers. These could be transferred to charts as illustrated here so that you and the children might have them for later reference.

Pages 16–23 · Young Animals

Some animals need much care.

Page 16 · The purpose of this page is to introduce boys and girls to a few of the mammals which take considerable care of their young. If

any of your children have observed lambs and colts, they might tell members of the group about their experiences. Lead them to recall what the animals were doing and how the mother cared for the colt or lamb. The boys and girls who have not seen these young animals, or even the adult animals, might have had experiences with other farm animals or with those at a zoo. Why do the children think the young needed help from the mother? Do they know how the mothers care for these young animals? Where have they seen the animals? Through such contributions, as well as by discussing the kinds of animals shown in the book, ideas can be gained about parental care.

Listen for spontaneous comments as the children look at the illustration. Lead them to discuss the ways the mothers are looking after their young. Are there other ways a mare cares for her colt? Are there other ways a ewe helps her lamb? Bring out the idea that animals which have few young, such as sheep and horses, provide much parental care. This makes it possible for their kind to survive.

Stimulate discussion of the explanation given in the text. Ask why these young animals need care. Bring out the idea that the colt and lambs need both food and protection from their mothers. Call attention to ways in which the mothers keep the young close to them so that they can be watched and protected.

Encourage discussion of the pasture in which these animals are shown. Ask why they need this kind of place. Stimulate the boys and girls who have seen sheep and horses to tell where the animals were and why it was a good place for them.

Other pictures of these animals might be provided for the bulletin board. As a result, new ideas may be gained from seeing horses and sheep in different situations. For those children who have not had experiences with these animals, it may be helpful to use numerous pictures.

Offer opportunities for boys and girls to organize ideas by painting pictures of young animals which they have observed. A discussion of these expressions may also serve to emphasize various kinds of animals and the parental care involved.

Some animals need much care.

Page 17 · When talking about the hen and chicks, insight may be developed into the ways in which some birds care for their young. Guide a discussion about the hen. How does she help her chicks to find food, keep them warm, and offer them protection? When answering the questions at the bottom of the page, some children may have much information to contribute. As they tell about chickens they have seen help

them focus on the hen's care of the chicks, including finding water and food for them, clucking to them, keeping them warm, and protecting them from harm.

A number of children may never have seen a hen with chicks. If school policy makes it possible to take study trips, sometime during the year you might be able to take the group to a place where they can observe a hen caring for her young. After you have visited the place yourself in preparation for taking the children, work with them in planning the trip. You may wish to list their questions, as well as gain permission for the trip from the principal and parents, determine the route and the means of transportation, and plan other details.

Another way to help children clarify concepts pertaining to parental care is to show a film, such as *Red Hen.* (See film list at end of Chapter II.) The Rhode Island Red hen in the film is the same breed as the hen pictured in the book. The film shows how the hen cares for her eggs, looks after the chicks, and teaches them to care for themselves.

Some children may bring magazine pictures of chickens from home. Possibly you can provide some to arrange on the bulletin board. These pictures will offer another source of information.

Some animals need much care.

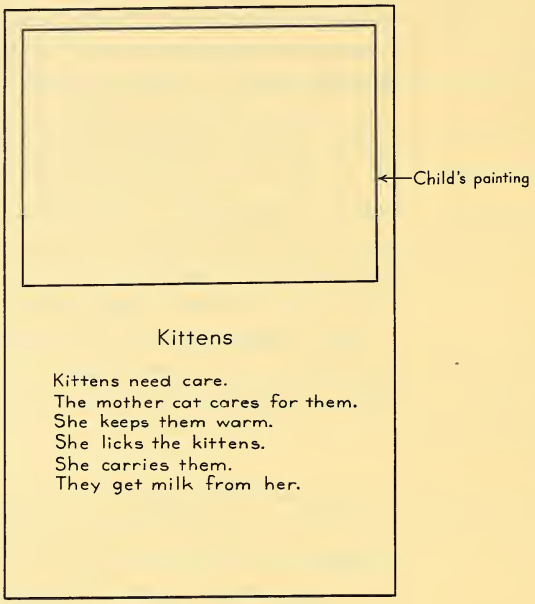
Page 18 · What spontaneous responses do the children make as they look at the cat and kittens on this page? Do comments show that some children are beginning to apply information and make interpretations involving parental care? Encourage the children to share personal experiences they have had with kittens and mother cats and assist them in relating their experiences to the questions at the bottom of the page.

Why do the children think kittens require care? Some child may be able to offer information about the condition of kittens when they are born and their need for help from the mother. Guide discussion of the illustration so that emphasis is given to the way a cat guards her kittens, cleans their fur, moves them from place to place, keeps them in a protected area, and furnishes them with milk.

It may be desirable to take the group to a place where they can observe a cat care for her kittens. Some child whose cat has kittens might extend an invitation to the children to come to his home. What do the boys and girls wish to find out from such a trip? Maybe their questions can be written on the board so that they can refer to them during the follow-up discussion after their walk. If the children are offered an opportunity to participate in planning for the walk, there may be many educational advantages in such an experience.

It is helpful for boys and girls to summarize information gained from

various experiences. Children's statements could be placed on a chart, such as the following, so that they might be read by the group from time to time. Some child might paint a picture for the chart, showing how his cat cares for her kittens. Similar records about other animals might develop from this experience.



Some animals need much care.

Page 19 · If children live near a lake or marshland, they may have seen wild ducks. Possibly some of your boys and girls have seen them in a city park. However, many young children will not have had this opportunity. Instead, some six-year-olds may have seen tame ducks and ducklings. As they recall their experiences guide them in telling how the mother duck cared for the ducklings. Those boys and girls who have not seen ducklings might refer to other kinds of birds with young and thereby learn about parental care in relation to birds in general.

What spontaneous remarks do individuals make as they look at the picture of the mallard ducks? Which comments relate to parental care? After the children have read the text, encourage them to discuss what they found out about how these mothers care for the young ducks. Help the children notice the way one duck sits on her eggs, the way the ducklings are protected by their mother as they swim in the lake, and also

the way she helps them secure food. It is the mother's part to care for the ducklings. The drake sometimes guards the nest, but he takes no part in caring for the young.

There may be a need to gain more information about ducks. It might be helpful to show a film such as *Seven Little Ducks* which gives information about hatching, feeding, watering, and housing a duck with ducklings.

Some animals need much care.

Page 20 · A few children may have seen bears in a park or zoo, but some six-year-olds will have received their knowledge of these animals only from stories and pictures. By listening to their spontaneous comments about the bears shown on the page, clues can be gained to the children's previous experiences and the kinds of concepts they hold. Encourage the group to speculate about the care this kind of mother might give her young. The children should give their reasons for making the suggestions. By discussing these illustrations, looking at other pictures of bears, talking with people who know about bears, and listening to stories giving accurate information, children may be guided in finding out how bear cubs are helped by their mothers.

Bears eat insects. In the picture a mother bear is shown looking in a rotted log for insects to feed her cubs. Besides insects she finds many other kinds of food for her young. In time of danger she makes her cubs go up a tree, as shown here, and keeps them there until it is safe for them to be on the ground. Bears offer considerable protection for the young and for a much longer time than do most animals.

Some young animals do not need care.

Page 21 · This page introduces the idea that some young animals do not need care from their parents. Instead, they take care of themselves from the very beginning. In order to contrast the life of these young animals with those having much care, this subject was presented on the page opposite the one about bears. What reactions do the children have to these illustrations? After they read the text, encourage them to suggest why they think these young animals do not need care.

While looking at the young grasshopper in the picture call attention to the fact that it is small and does not have wings. Develop ideas concerning the way grasshoppers care for themselves. Where have the children observed grasshoppers? Have they seen small ones which did not have wings? What did the large ones look like? Possibly you and the children can take a walk to a nearby place to see these insects. Offer guidance in observing in what kind of place grasshoppers live, the way

they hop, leaves which they have partially eaten, the size of the young in comparison to that of adults, and the wings on flying adults.

While studying the way young grasshoppers care for themselves, the children might be interested in knowing that an adult lays a large number of eggs in a hole in the ground near plants with the result that the young have food when they hatch. Even though many eggs are laid, relatively few of them hatch. Develop the idea that in spite of numerous hazards, survival of this species of animal is due to the fact that the female lays a large number of eggs. Also, boys and girls may come to see that these animals do not need the parent because they are able to secure food when they first hatch and because they have protection by living among plants.

Boys and girls may gain similar ideas about young snails. Encourage the group to tell where they have seen snails and what the snails were doing. Are any reasons offered as to why the young snails shown in the illustration do not need care from their parents? Holes in the leaves may give a clue for answering this question.

Some child may have seen snails near the school building. A walk to see them might be a profitable experience in learning about these animals. By using a magnifying glass, details of a snail can be seen easily. When observing snails, what questions do the children ask? What interpretations do they make? Bring out the fact that a young snail has the capacity to care for itself as soon as it hatches, and that the parent snail lays the eggs on plants so that when the young hatch they have the proper kind of food.

In order to observe a snail frequently, it might be advisable to have one in the classroom for a short time. If so, the group should plan first how they can house and feed it. Again, as with other animals, it is advisable to have a snail in the classroom for only a short time. For information about keeping a snail in a terrarium, see Further Experiences, page 56.

Tadpoles, or polliwogs, are other animals which illustrate the ability of some young animals to care for themselves. Both toads and frogs lay a quantity of eggs among grasses in a pond or swampy place which will be a suitable environment for their young. Then they swim away leaving the eggs to hatch and the tadpoles to eat food they find in the water. Many of the eggs do not hatch. However, enough hatch and live to maturity so that continuation of their kind is maintained. Ideas such as these may be gained by boys and girls as they find out about tadpoles.

Some children may have seen tadpoles, but many will have had no experience with these animals. Sometime during the year provision

might be made to have a few tadpoles in the classroom. For detailed information concerning the care of tadpoles, see Further Experiences, pages 56–57.

Some young animals do not need care.

Page 22 · Some other young animals which do not need parental care are illustrated on this page. Through discussion attention can be focused on the way young turtles have hatched from eggs, how they will have some protection in the water, the way they might secure food, and why the mother laid eggs in the sandy bank near the water.

If some of the boys and girls have seen turtles, lead them to speculate where turtles might lay eggs. How were the adults or young they saw caring for themselves? In what kind of place were the turtles living?

In order to help those children who have not seen turtles and to extend the experiences of others, it might be advisable to have a turtle in the classroom for a few days. If it is not possible to have young turtles, you may find there will be advantages in observing an adult. For more information about caring for turtles in the classroom, see Further Experiences, page 57.

The illustration at the bottom of the page shows the young of common mackerel caring for themselves. Ask such questions as: Why is the mother not here with the young fish? How can they care for themselves? Why do they need the plants? Help the children to develop the idea that most young fish receive no attention from their parents. Fish lay many eggs among plants in a suitable environment and then swim away, leaving the eggs to hatch and the young to care for themselves.

Some of the children may have seen young fish in an aquarium. By discussing such experiences, more information might be gained about the way young fish must care for themselves, the way their environment provides some protection, where the mother lays eggs, how the young appear when first hatched, and why many young fish do not live.

Page 23. Which Young Animals Need Care? The question on this page provides an opportunity to summarize ideas which have been gained about parental care. All the young animals shown on this page of the children's book have been discussed previously in the chapter with the exception of the puppy. Probably dogs and their young will have been considered as children talked about their pets, however. When recalling what they have learned about the needs of young animals, boys and girls may make numerous comparisons. They might begin to generalize about the reasons that some animals require much care in order to live and, in turn, produce young, whereas others receive no parental care.

To summarize in another way, lists of different kinds of young animals

might be dictated by the children. These could be recorded on charts in relation to each of the statements given in the book and used for later reference by the children. By drawing on their own experiences, as well as the illustrations in the book, boys and girls might know many animals to suggest for this kind of summary.

If you have a picture file in the room, some children might locate pictures which they can organize on the bulletin board under captions pointing up these large ideas or meanings. If children have made paintings of young animals, these might also be placed on the bulletin board with captions to reinforce the science learnings.

Materials Needed

For use with *Science Near You*:

- calcimine paints
- magnifying glass
- newsprint, 18″ × 24″
- pictures of animals

For use with Further Experiences:

- box with straw for hen's nest
- chicken wire for pen
- containers for food and water
- food for aquarium and terrarium animals
- food for hen and chicks
- glass tank or jar with cover for aquarium
- glass tank or jar with cover for terrarium
- hen and eggs
- newspapers
- plants and animals
- sand, soil, rocks, and moss
- water

Further Experiences

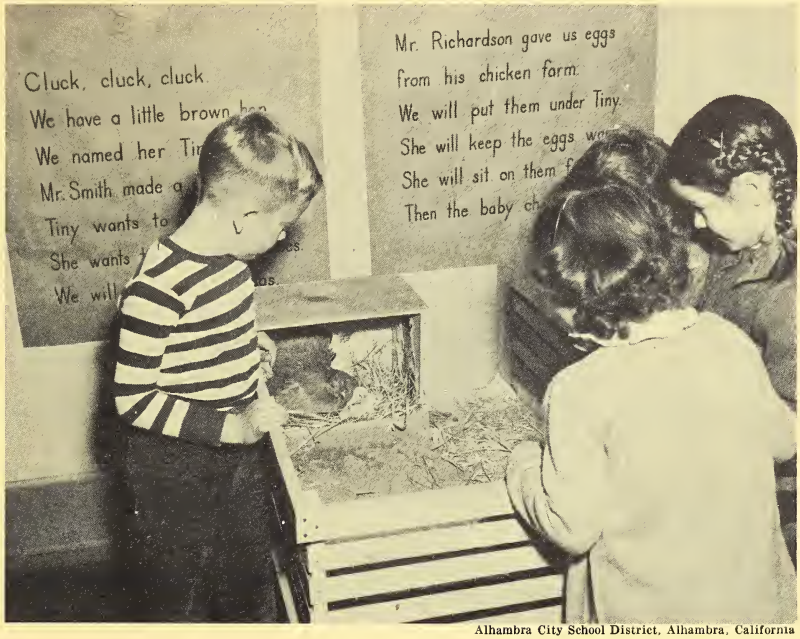
To accommodate the interests of individual children, their eagerness for additional activities, and certain possibilities in the environment, several ideas are suggested here for further experiences. Some of these might serve the individual differences among members of the group. All of the suggestions emphasize the science meanings developed in the chapter and therefore will help children reinforce their learnings.

Caring for a Setting Hen · You may be working in a situation which makes it possible for the group to have experiences with the care of a setting hen and the chicks when they hatch. If a setting hen and eggs can be obtained in the neighborhood, and if suitable arrangements can be made for keeping them at school, the children may derive a good background for making interpretations about parental care of chickens from firsthand observation.

Some breeds of chickens are better than others for use around boys and girls. Bantam, Plymouth Rock, and New Hampshire or Rhode Island Red hens are usually calm and not easily frightened. A hen should show a definite tendency to set before bringing her to school. However, a change of environment may disturb her, so that she will not settle down

on the nest immediately. When she does, place a setting of from twelve to fifteen fertile eggs under her. Only six or seven eggs should be placed under a Bantam hen.

A box lined with a considerable amount of straw or other nesting material may be used for the nest. Fresh water, laying mash, scratch grain, and grit should be available when the hen gets off her nest, usually once a day. Water and feed containers which the hen cannot upset should be used. A small enclosure might be made using one-inch mesh



Alhambra City School District, Alhambra, California

High value is placed on experiential learnings developed while children plan for having a setting hen, observe her habits, care for her, and watch chicks emerge from eggs.

chicken wire, eighteen inches wide. Spread newspapers on the floor of the pen. The young chicks do not need to be fed the first day because they have received enough nourishment from the yolk in the egg. After twenty-four hours feed them chopped egg and chick mash.

When planning for this experience, the boys and girls should participate with you in setting up their purposes for having the hen, preparing the nest, making the enclosure, and caring for the hen. For later reference they might keep records during this experience by marking dates on a large calendar to indicate the time it takes for chicks to hatch, or by making charts regarding their observations, or by other means.

Building a Terrarium · In order to have many opportunities for making certain observations and interpretations which cannot be made

conveniently outdoors, it may be well to work with boys and girls in setting up a terrarium. This is a land or combination land-and-water home for animals and plants. Conditions similar to those of the natural habitat of animals and plants can be created. A glass tank or large jar makes a good container for a terrarium. Besides the container you will need sand, plants, a considerable amount of soil, animals, and possibly moss and a few rocks. It is necessary to have a glass cover so that the animal and its live food cannot get out and also to prevent evaporation. A screen cover should be placed over a desert terrarium in order to keep it dry.

Both children and teacher can help in obtaining materials. It is desirable to obtain plants from the environment of the children. Soil should be taken from the same place as the plants so that it will be suitable. To care for an animal needing a moist land home, place about two inches of sand in the container to allow for drainage. Then cover the sand with a thicker layer of soil, and add plants. Moss and rocks may also be used. Grasshoppers, snails, or other small animals, such as toads, tree frogs, salamanders, and crickets, which live in this kind of environment, may be added. Desert animals require a warm, dry, and sandy habitat. For a desert terrarium use plants and soil from that type of environment.

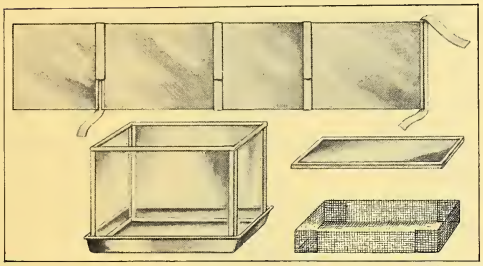
For food provide the kind of leaves the animal was eating when found and try offering it other kinds of foliage. Besides leaves, grasshoppers might eat celery and a piece of ripe banana. For snails add lettuce, celery tops, soft vegetables, and a piece of apple. Sprinkle the plants to supply the water needed.

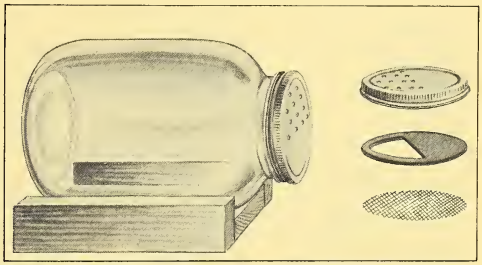
Some animals require a swampy type of home. They can be housed in a terrarium having a small pond as well as plants and soil. First spread about two inches of sand on the bottom of the container. Instead of placing soil and plants all over the terrarium, reserve about one third of the space for a pond. After the plants are in, place stones firmly against the soil and plants to form the bank of the pond. If the land section is rather high, the pond can hold enough water for tadpoles. Place a cover over the terrarium. When the tadpoles have developed to the frog or toad stage and need to live on land part of the time, the children may observe them going from one place to another in this kind of home. For further information about setting up terrariums, see pages 495–497 in Craig's *Science for the Elementary-School Teacher*, New Edition.

Tadpoles eat green pond scum (algae, a kind of plant) and other green plants. If water from a pond or pool is added frequently, tadpoles can eat microscopic animals and plants from it. They also eat corn meal, cooked oatmeal, and lettuce. Provide a very small amount of

food at a feeding. Frogs and toads eat insects, meal worms, and earthworms. Turtles eat commercially prepared foods, small insects, lettuce, small earthworms, and bits of hard-boiled eggs. Since the food should be placed in water it is advisable to take a turtle out of the terrarium at feeding time to prevent uneaten food from decaying in the pond.

When tadpoles are very young, they need to be in the water all the time. Therefore, it may be desirable to keep them in a large jar of pond water where they can get a quantity of food from the water. Add pond scum for food from time to time. Place the jar where the sun cannot shine on it. If the temperature of the water is changed quickly the tadpoles may die. When their legs begin to develop, transfer the tadpoles to a terrarium so that they can be out of the water part of the time.





Division of Elementary Education, Office of Los Angeles County Superintendent of Schools

Through planning for and building such a home for animals and plants, as well as caring for them, many experiential learnings may evolve. These experiences promote development of responsible behavior. Also children may come to see something of the relationship of an animal to its environment, as well as learn about the adaptations of animals for survival. It may be possible to have in the classroom some young animals besides tadpoles which do not need care by the parent. Thus ideas may be gained about ways in which various young animals look after themselves from the beginning.

A terrarium can be set up in a jar such as that shown at the right in the drawing above. Use a nail to punch holes in the lid from the outside. Then cut a circle of screen and one of heavy cardboard to fit inside the lid. After cutting out a section of the cardboard circle, as shown, cement the two circles together. Insert them into the lid, leaving the cardboard on the outside. Make a wooden base for the support.

Another type of container for a terrarium might be constructed as shown above in the drawing at the left. Use five pieces of glass, a rectangular cake pan, adhesive tape, and galvanized screen. First cut

four pieces of glass 9 inches wide to fit inside the pan. Lay them flat, as shown, with $\frac{1}{4}$-inch space between them. Fasten tape to the glass edges on both sides and lap the ends. Bind the top and bottom of the glass with tape. Join the two ends of the glass panel, fasten them with tape, and place the rectangle in the pan. For the cover, bind the fifth piece of glass, which has been cut 1 inch wider and longer than the top of the completed tank. If a screen cover is needed, make it by bending the edges of a galvanized screen rectangle, which also has been cut 1 inch longer and wider than the top of the tank.

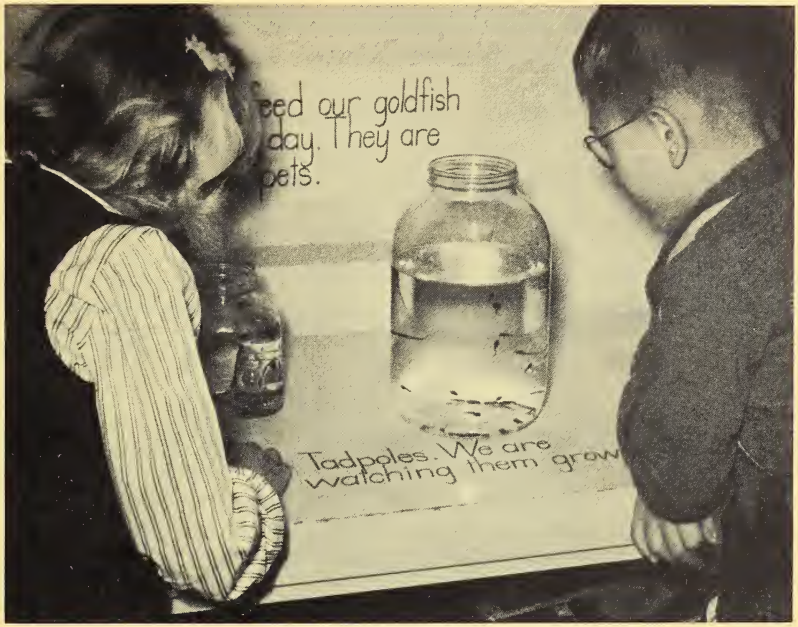
Building an Aquarium · If there is an aquarium in the classroom, the children may be stimulated to ask many questions and make interpretations about the way fish and other water animals live. Boys and girls need an opportunity to develop resourcefulness and responsibleness by planning with the teacher for such an experience, helping obtain materials, and participating in setting up this kind of animal home. After deciding why they want to have fish in their room, the children will need to find out where these animals can be obtained, such as from an outdoor pool, a pet shop, or a store carrying aquarium supplies. Since goldfish are very hardy and easy for young children to observe and care for, it is suggested that they be used.

Besides fish, it will be necessary to secure a rectangular glass tank which holds from three to four gallons of water, sand, a number of smooth stones, water plants, water, and a glass cover for the tank. The children might be able to help in obtaining sand and smooth stones. The sand should be cleaned by placing it in a good-sized cloth sack and washing it outdoors with a hose until the water runs clear, or by dousing the sack of sand in pails of clean water. Have the children put about two inches of washed sand in the bottom of the tank, which also has been washed thoroughly and placed where it will have indirect light. (Direct sunlight will heat the water too quickly and, in turn, kill the animals.) The washed stones should be added and used to anchor sand around the roots of plants. Water plants may be purchased from a store handling aquarium supplies, or taken from an outdoor pool or a nearby stream.

Before adding water, place a piece of paper over the plants, sand, and stones. Pour the water on the paper to prevent the plants from being uprooted. Fill the tank with water, remove the paper, and allow the water to stand overnight so that it will be the same temperature as that containing the fish. The amount of water in the tank will determine the number of fish which can be accommodated. It is suggested that one inch of fish per gallon of water be the guide in estimating the number of fish to stock an aquarium. To prevent evaporation, cover the tank

with a sheet of glass. The glass cover also keeps dust and other material from getting into the water. As a safety measure, it is advisable to bind the glass around the edges with one-inch adhesive tape so that the children will not cut themselves.

Fish may be placed in the aquarium after the temperature of the water has become the same as that in which the fish were obtained. Several snails may be added. They act as scavengers to eat excess food and algae which tend to collect on the sides of the tank. Large tadpoles



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While observing growth of tadpoles from day to day children's concepts are deepened.

may also be used in this water home. If the water is about 70° F., the fish should be fed daily. They are more active at higher temperatures and therefore need more food than at lower temperatures. Feeding balanced commercial fish foods is suggested. If all of the food is not eaten, a smaller amount should be fed the next time.

Sometimes goldfish lay eggs among plants in an aquarium. If so, there may be an opportunity to see the young develop, providing the adult fish are removed from the tank so that they will not eat the young. The snails may also lay eggs on plants, and these may hatch, too. Some water snails bear their young instead of laying eggs. From experiences with aquarium animals boys and girls may broaden and deepen their concepts regarding young animals which do not need parental care. For

additional information about setting up an aquarium, see pages 491–495 in Craig's *Science for the Elementary-School Teacher,* New Edition.

Viewing and Discussing Films · To extend children's experiential learnings about the care of kittens by a mother cat, a film such as *Three Little Kittens* listed at the end of this chapter might be shown. It is advisable to preview the film before showing it to children in order to guide their observations effectively. Provide time for them to discuss the parts they especially liked, ask questions, consider ways the mother cat cared for her kittens, and compare these with the way they have observed cats look after kittens.

Seeing *Poultry on the Farm,* another film listed at the end of this chapter, will help children learn about the care of chicks, goslings, and ducklings. Other films may be shown to illustrate adaptations of animals in caring for their young as well as to show how various young ones care for themselves from the beginning.

Evaluation

Children's experiences are of much consequence. The term *experience* is a significant one in the field of science and science education. It is through experience that much, if not all, of man's interpretations come. In what ways have members of your group drawn upon their past experiences? Which children talk freely about their experiences with animals? What evidence is there that some boys and girls tend to exaggerate? What instances give evidence that their attitudes and behavior toward animals have been changing? After observing a hen care for her chicks, listening to young birds as they call for their mother, or watching tadpoles care for themselves, boys and girls may tend to change their behavior.

Some children develop traits that are sadistic and cruel in reference to other living things. Is this a problem in your group? Is some child changing this kind of behavior and beginning to show that he can be responsible when caring for an animal? In what way is planned behavior taking the place of impulsive actions as children handle animals?

Which children are developing more initiative and resourcefulness in looking for animals around home as well as on the school grounds? Who is sharing such experiences? Which boys and girls are suggesting walks to obtain more information? In what way are they gaining skill in setting up purposes for taking a walk or planning to keep an animal in the classroom? What satisfactions are accompanying such purposes as being quiet on a walk, not disturbing the natural environment, and staying in a group?

What instances indicate that some of the children are changing their ideas about the reason various animals do not need care from their mothers? What kind of thinking are they doing relative to the larger ideas concerning adaptations of animals for survival? What relationships are some children beginning to see between the different kinds of parental care given young animals? What spontaneous comments have carried positive value for the group and moved forward their study about the adaptations of some animals? How are individuals utilizing their learnings and applying them to new situations? What references are made to the preceding chapter about animals?

Bibliography

For the Teacher

Blough, Glenn O., and Campbell, Marjorie H. *Making and Using Classroom Science Materials in the Elementary School*, pp. 39–73. The Dryden Press, 1954.

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 223, 242–244. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 488–497, 574–579. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition. Wm. C. Brown Company, 1955.

For the Children

Baldwin, Victor and Jeanne. *Little Kitten, Big World.* See the Bibliography for Chapter II.

Brown, Margaret W. *Young Kangaroo.* William R. Scott, Inc., 1955. Factually accurate, this story of the growth and development of a baby kangaroo will delight children of any age. Excellent illustrations enhance its charm.

Earle, Olive L. *Robins in the Garden.* See the Bibliography for Chapter II.

Huntington, Harriet E. *Let's Go to the Brook.* For this book and others by the same author see the Bibliography for Chapter II.

Kane, Henry B. *Wild World Tales: The Tale of the Mouse, the Moth, and the Crow.* See the Bibliography for Chapter II.

McClung, Robert M. *Spike: The Story of a Whitetail Deer.* William Morrow and Company, Inc., 1952. A well-illustrated and simply written story giving information about a fawn and its mother in the big woods.

McClung, Robert M. *Stripe: The Story of a Chipmunk.* See the Bibliography for Chapter II.

Morgan, Alfred. *Pet Book for Boys and Girls.* See the Bibliography for Chapter II.

Schloat, G. Warren, Jr. *The Wonderful Egg.* Charles Scribner's Sons, 1952. Excellent photographs and descriptive text providing information about the incubation of eggs; growth of chicks; their care; and the production, storage, and marketing of eggs.

Schwartz, Charles. *Cottontail Rabbit.* See the Bibliography for Chapter II.

Webb, Addison. *Birds in Their Homes.* See the Bibliography for Chapter II.

Weil, Ann. *Animal Families.* See the Bibliography for Chapter II.

Witty, Paul, and others. *Gray Squirrel.* See the Bibliography for Chapter II.

Films

Animals Growing Up. See the film list for Chapter II.
Baby Animals. (YAF) 1 reel, b/w. Focuses attention on resemblance of young to mother, parental care, and habitat of pigs, Canada geese, deer, pelicans, skunks, raccoons, and opossums.
Birds in Your Backyard. See the film list for Chapter II.
The Bluebird. See the film list for Chapter II.
Common Animals of the Woods. See the film list for Chapter II.
Dairy Farm Calves: Daisy and Becky. (Frith) 1½ reels, color. Stresses the care, feeding, housing, and training of calves at a large dairy.
Farm Animals. See the film list for Chapter II.
Five Colorful Birds. See the film list for Chapter II.
Frisky, the Calf. (Cor) 1 reel, color and b/w. Shows parental care and development of young calf as well as its relationship to a little girl.
Littlest Puppy Grows Up. (Frith) 1 reel, color. Shows the care, feeding, and early training of a puppy.
Pig Tales. See the film list for Chapter II.
Poultry on the Farm. (EBF) 1 reel, b/w. Illustrates ways some animals care for their young, including chickens, ducks, geese, and turkeys.
Red Hen. See the film list for Chapter II.
Seven Little Ducks. (Bailey) 1 reel, color and b/w. Focuses attention on way a girl cares for a family of ducks in the yard.
Spotty, the Story of a Fawn. (Cor) 1 reel, b/w. The adventures of a wild fawn shown against the authentic background of the north woods.
Three Little Bruins in the Woods. See the film list for Chapter II.
Three Little Kittens. (EBF) 1 reel, b/w. Shows activities and growth of kittens and the way mother cares for them.
Younger Generation. (McGraw-Hill) 1 reel, color. Shows the feeding habits, care, and antics of baby animals in the Bronx Zoo.
Zoo Babies. (Cor) 1 reel, color. Answers questions about zoo animals and their offspring.

Filmstrips

Billy and Nanny (The Twin Goats). (EBF) color and b/w.
Black Bear Twins. (EBF) color and b/w.

IV

Magnets

By trying out ideas gained from "Magnets" in *Science Near You* children may extend their experiences with energy through a force which has significant social implications for their own lives as well as for society. This force of magnetism, which probably operates throughout the universe, can be felt by a child as he works with magnets. Children even as young as three or four years can begin to build meanings and develop a feeling for energy by handling magnets such as those in their toys. Six-year-olds can enlarge their interpretations of such experiences, which in turn may be extended throughout their lives.

Some of the phenomena of magnetism presented in *Science Near You* are in the form of experiences for children. Several situations involve the attraction of materials by magnets. A number of others are used to call attention to those materials which a magnet will not attract and to lead a child to make comparisons. Several illustrations are designed to point out that magnetism passes through many substances. This significant characteristic makes it possible to utilize the energy in industry as well as in everyday living. When experimenting with magnets, boys and girls may discover for themselves that magnetism goes through some materials.

Throughout the chapter emphasis is given to differences in magnets. As boys and girls have an opportunity to use several magnets they will come to observe some of these variations. For example, they differ in size, shape, and color. Also some magnets contain more magnetism than others. *Science Near You* provides guidance for the teacher in helping children develop concepts concerning magnetism. The chapter might be presented to introduce ideas about this force. It might encourage children to investigate and try experiments as well as help them become more resourceful in carrying on such activities. The chapter also might be introduced for the purpose of extending experiential learnings which some of the children have developed while playing with their toys or in other situations.

Science Meanings for Children

The following science meanings are developed in this chapter:

Magnets attract some things.
Magnets do not attract some things.
Magnetism goes through some things.
There are many kinds of magnets.

Science meanings may be developed gradually by young children as they investigate, try out their own ideas, discover for themselves, and talk with others. Their interpretations of magnetism will be in a direction rather than in terms of achieving an end point of accuracy. In fact, man, including the scientific experts on magnetism, does not have the final information about magnetism and related phenomena for all time. There are likely to be great revolutions of thought ahead for mankind in this field.

The science meanings in the chapter should evolve as a result of experiences directed toward the larger ideas concerning energy. These larger ideas will be developed further in the next section.

Information for the Teacher

A three- or four-year-old child may have experiences with magnetism. When playing with his toy car equipped with a magnet, he has experiences with the push and pull of magnetism. He may be able to make the car go forward or backward by using a gadget which contains a magnet. Thus he finds that the magnet has force and he actually feels its push and pull. Through such a play experience he begins to develop meanings and to build up a feeling for force and energy.

Besides experiencing the phenomena of magnetism through toys, the five-year-old may have access to a magnet which has been obtained from a store, garage, junk yard, or some other place in his neighborhood. He may be surprised to find that a little piece of steel can exert a force outside itself and attract some objects and not others. Possibly he recognizes that this force extends into the space around his magnet even though he cannot see the force. In other words, he is finding out that the magnet has a field of attraction. Thus an elementary but basic concept of force and energy in space which involves the magnetic field surrounding a magnet can be developed. The term *field* does not need to be used with a young child. However, he can gain experiential learnings which will help him later in understanding the concept of the magnetic field.

The six-year-old builds his ideas about magnetism around his past experiences and the new discoveries he makes for himself. He may have had some contact at home or in the neighborhood with gadgets involving magnets. Possibly he uses a magnet to pick up nails when they are spilled or when he helps mother clean the kitchen drawers. He may have asked, "Why does a magnet pick up some things and not others? How does a magnet work?" Through various activities his learnings may be extended toward the larger idea of force, energy, and magnetic field.

Throughout childhood, boys and girls may increase their experiential learnings with the phenomena of magnetism. They will make ever-enlarging interpretations and these in turn can be extended throughout life. In the world of tomorrow children are bound to hear more and more about magnetism.

The following information may help a teacher develop a useful background regarding magnetism. Not all the facts given here will be used with the children. However, the material may offer direction for guiding their concept formation.

The force of magnetism probably extends throughout the universe. This is indicated in sunspots, in distant stars, and in the cosmic rays that strike the earth. The earth is a gigantic magnet with invisible lines of magnetic force extending from the south magnetic pole to the north magnetic pole, making a magnetic field around the entire earth. This magnetic force is the one to which a compass immediately responds and is the same as that in children's magnets.

Magnets have a north pole at one end and a south pole at the other. The magnetic field of a magnet is between and about its poles. Therefore, the magnetic force of attraction is greater near the ends. In the U, V, and horseshoe magnets the poles are close together. This produces greater strength, and thereby greater lifting power. When unlike poles of two magnets are placed together, they attract each other. In the opposite position the like poles repel each other.

Magnets attract objects made of iron or steel. They also attract cobalt and nickel; however, young children are not likely to have these metals. Magnetism passes through many kinds of materials, such as wood, glass, paper, plastic, and copper, instead of attracting them. If a magnet does not attract iron or steel objects through one of these materials it may be because the material is too thick. Little, if any, magnetism passes through iron or steel.

Magnets are made in different shapes. The most common are the bar, U, V, and horseshoe magnets. Even though the shapes differ, the action is the same in all magnets. However, some may have more

magnetism than others. Frequently magnets get weak because they are not cared for properly. To prevent a magnet from losing some of its magnetism, place a keeper across the poles when it is not in use. The keeper is a small bar of soft iron long enough to extend over both poles. When bar magnets are not in use, they should be stored so that the opposite or unlike poles will be together. Since the unlike poles continually attract each other when the magnets are in this position, the atoms do not become disarranged. When a magnet is dropped, the atoms may become disarranged, thus destroying some of the magnetism. Exposure to heat also may affect the strength of a magnet.

Man knows a great deal about what magnetism can do, but he does not know just why magnets are magnets and is not sure why magnets behave as they do. Scientists who have studied magnetism are not only unable to explain all about big magnets but they are also unable to explain what is in a tiny magnet. Therefore, you may have no hesitation in admitting that you do not know the answers to some questions the children may ask. The men who study these things have much to learn too.

Many experts on magnetism think that it is a force which is due to currents of electrical particles in magnets. The smallest particle of iron or steel in a magnet is the molecule, which in turn is composed of atoms. It is thought that magnetism is caused by the relationship between the various particles which make up the atom. No scientist has found a perfect explanation of magnetism. Children will have opportunities to find out more about the nature of magnetism at a later level.

Children are often as interested in what they cannot see as in what they can see. They never have an opportunity to see magnetism. In fact, no one ever does. We only see its effect. In later years children may find out that it is impossible to see any form of energy or force. Instead, we just see what energy or force does.

Magnetism has been put to use in ways which greatly affect the daily lives of boys and girls. Without magnets there could be no telephone, telegraph, radio, television, doorbell, or compass. Magnetism has made it possible to build the electic motor, and thus everyday living of children is influenced by the introduction of such appliances as electric refrigerators, vacuum cleaners, and washing machines, as well as various machines in industry. The food children eat may have been subjected to the force of a strong magnet. As a safeguard, many food processing plants use magnets to attract pieces of iron which may have got into grains, vegetables, fruits, or meats. Magnetism plays a very important part in the lives of children even though they may not be aware of this force.

For additional information about magnetism you may refer to pages 716–738 in Craig's *Science for the Elementary-School Teacher*, New Edition.

Ways of Working with Children

Your group of children may have become concerned about magnets through the use of equipment or toys. In that case, you may want to use the material in *Science Near You* to extend their experiences. Or the book may be used to introduce the subject of magnetism, provoke curiosity, and inspire children to discover for themselves. It might motivate them to bring materials for experimentation and prompt them to carry on activities at home as well as at school. The chapter on magnetism may be introduced at any time during the year.

Pages 24–31 · Magnets

Magnets attract some things.
Magnets do not attract some things.

Page 24 · While children share experiences they have had using magnets questions may arise and suggestions be made for further activities. Someone may have used a magnet to clear benches or tables of materials as John is doing in the illustration. Another child may have found a magnet helpful to pick up spilled nails or to retrieve iron or steel articles

Manipulation frequently takes on an investigative trend and contributes to concept formation.

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from an inaccessible place. Others may have used magnets just to find out what they will attract or will not attract.

The discussion of their experiences may lead children not only to consider the kinds of materials their magnets have attracted, but also to observe the articles in the picture which John's magnet is attracting. Try to secure several magnets so that members of your group may have the experience of manipulating, investigating, and trying out their ideas.

Ways to Use Our Magnets

Pick up nails in the shop.
Pick up things for Mother.
Clean our workbench drawer.
Clean drawers in the kitchen.

There will be many occasions for children to discover for themselves some materials magnets will not attract. Can an opportunity be provided for them to see if their magnets will attract shavings, sawdust, and scraps of wood in order to better interpret John's experience?

As you listen to children discussing their activities and attempting to make explanations you will hear them expressing in different ways the idea of the magnet attracting materials. They may use the words *pull, push, pick up,* or *sticks.* Begin with the children where they are in communicating ideas, but keep in mind that you will want to introduce the term *attract,* which best expresses the action of a magnet. The authors have introduced *attract* on page 25. If children establish it in their oral vocabulary through many associations, they will doubtless be able to read it easily when they find it in the text.

Motivate the children to discuss what John may have found out about his magnet. You might ask: What is the magnet attracting? What things in the shop might it attract? Help children read the text for the purpose of finding out how John is helped by using the magnet. Then discuss their reactions to the reasons John is using the magnet. After their own experiences of finding out how easy it is to attract nails, screws, washers, and bolts with a magnet, children may be ready to comment on the reason John can clean up his workbench so fast. After a child reads the question on page 24, what comments are made by the group?

Possibly John's use of his magnet may give the children clues to what they might do with their own magnets. Guide them in thinking of

possibilities for using their magnets at school and at home. Maybe it will be helpful to develop a chart of plans for ways to use magnets with the idea of adding other activities when more ways are found. An example of such a chart is given on page 68.

Magnets attract some things.
Magnets do not attract some things.

Page 25 · Magnetism offers many situations for learning through experimentation. Therefore, it is desirable to provide numerous opportunities for boys and girls to use magnets. Some members of your group may be able to bring their magnets to school. If several magnets are available, much participation can be expected. The page is designed to prompt children to use their magnets to attract objects, such as the ones pictured. The number of unrelated objects on the page might arouse curiosity and therefore lead to reading the question at the bottom of the page.

After the boys and girls have discussed the pictures and read the question, you might record their reactions as they anticipate or speculate about what they think a magnet will attract. If these hypotheses or expectations are recorded on a chart, the children can refer to them later after testing their ideas by experimenting. They may find that some of the results are not as they anticipated. They will need to check the chart and mark the items which differ from their findings.

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Sharing his discovery that magnetism goes through cloth gave Sammy a sense of achievement.

It is hoped that situations presented in the book may prompt children to question, plan ways of finding answers, and try out their ideas by experimenting. Concepts also may be deepened as children listen to the explanations of other people, observe experiments performed by boys and girls, and weigh information before drawing conclusions. Out of these experiences the group might summarize what they have learned by cutting pictures from magazines and organizing these on charts with titles such as "Magnets Attract These Things" and "Magnets Do Not Attract These Things." Or, the children might tape on charts the actual articles which have been tested, such as a feather, piece of cloth, nail, or a small plastic toy. You and the children may plan various ways of organizing their learnings in order to make interpretations and draw conclusions.

Magnets attract many things.

Page 26 · Magnets attract many articles which are made of iron or steel. To emphasize this meaning, the same U magnet is shown in the four illustrations, but each time it is attracting a different article. The last line of text might serve to recall the great variety of things the children have found a magnet will attract. If charts have been used, reference may be made to them when discussing the page.

Have the boys and girls tried with their magnets to attract the kinds of objects shown in the book? Is anyone skeptical as to whether or not all of these articles can be attracted? Do you see evidence of guessing being rejected? Instead, is there a readiness to verify their ideas? Here is an opportunity to guide the children into verifying information in the book by doing experiments.

Magnets do not attract some things.

Page 27. Experiments with Magnets · Are your children beginning to apply their learnings in different situations? Are they becoming resourceful in trying out their ideas without special guidance from you? Listen to their spontaneous reactions about the illustration at the top of the page. Do they see how John and David are trying to fool Betty? Do the children think Betty will lose her hat? Are they able to back up their ideas? If they are not sure, do they suggest how they can find out? After some experimentation, lead them to read the text under the picture and thereby begin to develop the habit of reading to check ideas.

The purpose of the illustration at the top of the page is to encourage children to try similar activities and make interpretations. If this is done, it may be demonstrated how magnets do not attract cloth and leather. Also, through such experimentation with clothing, the children

may find out that magnets attract certain buckles, buttons, clips, and anything else used on clothing which has iron or steel in it.

The familiar situation at the bottom of the page provides another opportunity for children to apply their learnings regarding articles Betty and John cannot attract with magnets. Lead children to read and find out what Betty is telling Mary and the boys. The picture may motivate the group to find materials similar to those on the table and to see if

any can be attracted by a magnet. To encourage children to make comparisons, this illustration is placed opposite the page which develops the science meaning, magnets attract many things. Likenesses and differences also can be emphasized by children if they organize their own materials in two boxes which might be labeled "Will Attract" and "Will Not Attract," or "Yes" and "No."

Magnetism goes through some things.

Page 28 · Because magnetism passes through nonmagnetic materials, magnets can be used in a variety of ways. The humorous situation which shows a magnet attracting the can through Betty's hat introduces another science meaning. The magnet is attracting the can because of the iron in it rather than the tin which is used as a coating over the iron. Therefore, magnetism is passing through both the felt of the hat and the tin on the outside of the can.

After discussing this illustration, the children might try to find out if magnetism will go through their own hats and other types of clothing. You might help them record such information on a chart by using pictures or by making lists as follows:

Magnetism Goes Through Our Clothes

hats	dresses	shirts
caps	coats	sweaters
shoes	socks	aprons

In the illustration at the bottom of the page magnetism is shown passing through cardboard and attracting the wheel. Various kinds and thicknesses of paper need to be used in trying this experiment. A weak magnet may not be effective through thick cardboard.

What questions do your children ask when studying these illustrations? Encourage them to think of other kinds of materials they might test with a magnet. After testing their ideas, they need time to demonstrate and discuss their findings with the group.

When the children are through experimenting, encourage them to leave their materials in a special place so they are readily available to other children who may wish to try the experiments. It is important that boys and girls have these sensory experiences themselves rather than just observe someone else do the experiments. Therefore, there is need to plan for a time when they can work independently. For instance, several children might carry on by themselves in trying these experiments when you and the rest of the group are involved with other activities.

Magnetism goes through some things.

Page 29 · Some members of your group may have found out that magnetism goes through water and wood. If not, the illustrations on the page can be used to introduce this fact. The amount of water or thickness of wood that magnetism passes through will be determined by the strength of the magnet. Observe the children to see if any of them are drawing conclusions too quickly after only one experience. They might decide that magnetism will not go through water or wood as a result of using a weak magnet. Instead, they should try using several magnets, thus gathering considerable evidence and weighing the findings before making interpretations and drawing conclusions.

There may be some place in your school or neighborhood where children can see this characteristic of magnetism being utilized. An industry may use magnets under a conveyor belt for the purpose of attracting iron or steel pieces from the product being conveyed. It might be possible to visit a small feed mill where magnets are placed in the chute to collect iron scrap before the grain drops into the mill. Such an experience provides opportunities to apply information and find out that many people make use of magnets. Also, of course, profitable learnings may evolve from planning such a study trip, listening to explanations, observing, and making interpretations.

Some magnets do not look like others.

Page 30. Magnets · The shape, size, and color of magnets vary. However, the V, U, and horseshoe magnets are different shapes of the same kind of magnet. All of these are essentially a bar magnet which has been bent into a certain shape. Some magnets are large and some are quite small. Another difference illustrated in the textbook is the color. To give emphasis to these differences, the magnets of various shapes and colors are shown attracting the same object.

The magnets you and the children use will vary in different ways also. Comparisons may be made between your magnets and those illustrated. Possibly the children will use magnets which are not like the ones in the illustration, such as a small bar magnet. This kind of magnet is used in many toys, pencils, and various types of equipment.

Page 31. What Can Betty Do with Magnets? The last page is designed to help children summarize and begin to generalize in drawing conclusions. Through a discussion of what Betty is doing with magnets, there may be many references to the situations given in *Science Near You* and also to the wide experiences of the children. The last line of text may prompt some of the children to make a general summary of experiments they have done. Also it may serve as a review and lead children to go back and examine each page again to see if they recall the experiments suggested in the textbook.

Materials Needed

For use with *Science Near You*:

apple
apple crate or box
ball
banana
bobby pins
cardboard
cardboard boxes
child's hat
cup
doll dress
glass container, large
hammer
horn
iron wheel
key

large and small U, V, and horsehoe magnets
(Secure magnets from hardware store, variety store, radio repair shop, car-wrecking yard, junk dealer, or equipment supply house. See Appendix for addresses of equipment supply houses.)

nails, screws, washers
pictures
pie pan
ribbon
ruler
sand pail and shovel
scissors
screw driver
spoon
string
teddy bear
tin can
toy clown
toy top
wood scraps, shavings, sawdust

For use with Further Experiences:

bowl, large
magnet
needle
paper
wood scraps

Further Experiences

Seeing a Big Magnet at Work · Is it possible for your boys and girls to observe permanent magnets in use? One might be found in the school cafeteria, or the custodian might be able to show one in a machine. The mechanic in the garage nearby may have magnets which he uses to hold a trouble light on a car or to lift pieces of iron from places that are difficult to reach. You may wish to plan with the children for interviews with adults who use magnets and a visit to some place nearby to see magnets in use.

Making a Magnetic Toy · Make a boat out of a small piece of soft wood. Cut out a square of paper for a sail. Use a steel needle stuck into the wood for a mast. Float the boat in a large bowl of water. Hold a magnet near the boat. The magnet will attract the needle and pull the boat wherever the children want it to sail.

Evaluation

When using *Science Near You* and observing the children as they carry on a great variety of activities with magnets, you may notice some changing behavior among members of the group. You may see them applying their learnings to new and different situations. They might try to find objects their magnets will attract or learn if magnetism passes through anything other than objects illustrated in the book. What questions are they asking about magnets? How has their ability to anticipate, predict events, or set up hypotheses improved, and do they show more

willingness to test their ideas? In what ways have they exhibited resourcefulness in suggesting experiments, planning, and carrying on their activities?

Through their spontaneous behavior in analyzing illustrations in the textbook and doing experiments, children may show considerable ability to interpret situations. In what ways are they growing in independence in initiating activities rather than waiting for you to suggest what they might do with their magnets? What evidence is there that the boys and girls are deepening their concepts of magnets and magnetism? Which children are beginning to tell about follow-up experiences they have had at home? If you observe boys and girls in your group improving their behavior as a result of these experiences, you will know that much learning is taking place.

Bibliography

For the Teacher

Arey, Charles K. *Science Experiences for Elementary Schools*, pp. 50–59. Bureau of Publications, Teachers College, Columbia University, 1942.

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 417–422. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 716–738. Ginn and Company, 1958.

For the Children

Branley, Franklyn M., and Vaughan, E. K. *Mickey's Magnet.* Thomas Y. Crowell Company, 1956. Lively illustrations may stimulate children to perform the simple experiments with magnets suggested in the text.

Podendorf, Illa. *True Book of Science Experiments.* Childrens Press, 1954. Simple science experiments for children to perform. Includes several experiments on the use of magnets.

V

A Way to Go Up and Down

Our democratic way of life depends to no small extent upon the ability of people to be resourceful and responsible in operating machines for the good of mankind.[1] It is important that young children learn to work with simple, safe machines such as ramps. "A Way to Go Up and Down" can be used to help boys and girls develop an awareness of this mechanical device which they may use every day. Also it might lead them to consider how ramps aid them in their work and play. The ramp, or inclined plane, enables children as well as adults to carry on some of their activities more efficiently. Objects too heavy for people to lift can be moved up or down more easily by using a ramp. People can go from one level to another with the aid of an inclined plane.

Sometimes children need to move their wheel toys and other equipment up and down steps. To facilitate easy movement, an inclined plane or ramp might be used as shown in the book. If attention is focused on the way their work is made easier, children might begin to see the significance of a ramp.

During their play, boys and girls often find use for ramps. They build inclines with their floor blocks so that they can push their trucks, trains, and cars over bridges and up hills and mountains. Sometimes they spend considerable time on the playground walking up and down inclines which have been made by securely fastening boards on slightly different levels. While playing in the sandbox they frequently make winding roads around and over hills and talk about going up and down. From time to time children see adults going up and down ramps or using them as they move heavy loads. These activities may be imitated in children's play and thereby offer additional experiences with the inclined plane.

Ideas can be gained from the book about ways ramps might be used to help in play and work activities. Perhaps by using *Science Near You*

[1]See the Foreword, pp. viii-x.

boys and girls are prompted to make observations in the neighborhood or see places where ramps are utilized around their homes or at school.

By making comparisons between how hard it is for them to lift an object up to a certain place and how easy it is to move the object on a ramp to the same place, children gain a basis for determining why people use ramps. Energy is involved in such an activity, thus a child may begin to have a feeling for the force which must be exerted in moving things from place to place or in walking and running up and down an incline. He will have many opportunities to have experiences with the pull of gravity as he uses ramps in his work and play.

Science Meanings for Children

The following meanings are developed in the chapter:

Ramps make it easy to go up and down.
Ramps make it easy to move things up and down.

The purpose of the book is to stimulate thinking concerning the significance of ramps, to lead children to observe where ramps are located, and to encourage firsthand experiences which will develop some understanding of the reasons people utilize this kind of machine. These meanings relate to energy which is involved in the large basic pattern of change.[1] When articles are moved up and down ramps or when people go up and down these inclines, energy is involved. Boys and girls can gain a feeling for energy as they carry on activities such as those suggested later in this Manual.

Information for the Teacher

Children have experiences with ramps when they are very young. They walk up and down steps, pull their wheel toys up and down inclines, and ride on highways built up and over hills. By the time they are six-year-olds, they use ramps at school as well as at home and in the neighborhood. There may be ramps in the school building; the street may be on a hillside; and sidewalks may be on inclines. A child glides down the playground slide, delights in running down a slight incline, and coasts down the snow-covered hillside on his sled. Such

[1]For further discussion of the pattern of change, see the Foreword, pp. xviii–xix.

experiential learnings help build a background for making interpretations concerning the effectiveness of ramps.

Energy is involved in the children's "up-and-down" activities. A child has experiences involving energy from the time he is born. He displays a tremendous amount of it as he exercises his muscles by pulling, pushing, and twisting, just as other animals do. He uses the energy of his muscles to move something, whether it be his arms, legs, eyes, a rattle, blocks, wagon, doll buggy, or shovel. Gradually he finds out how machines assist him in his activities and that by using them he need not exert so much energy. He uses a ramp when moving his toy truck filled with blocks from one level to another and considers it an easy way to accomplish what he wants to do. The ramp or inclined plane is a machine because it enables people to do work with the expenditure of less muscular force.

Many adults think of machines in the traditional sense, that is, as something made of iron and containing cogs and gears. However, many machines are simple, such as the inclined plane. This simple machine is merely a sloping surface which makes it easier for people to move objects from one level to another or to go from one height to another themselves.

Ramps or inclined planes may be observed being used in many places in the country as well as in the city. The farmer may load cattle or other animals into his truck by driving them up a ramp or chute. Sometimes farmers build ramps so that they can drive into their barns at different levels. A wide board extending from a truck to a loading platform makes it possible for a driver to roll barrels or slide boxes to a lower level. The groceryman unloads vegetables, fruits, and other supplies from a truck on to a dolly which can be pushed up a ramp. Conveyor belts sometimes are constructed as inclined planes. Ramps are frequently used in garages so that cars can be driven to different floors. Some bridges have ramps at each end for approaches. The inclined plane is used in many complex machines in combination with some of the other simple machines, such as the pulley and lever. Observations made in the community will show that people make considerable use of this machine.

To summarize—it is easier to raise or lower a weight over a long ramp than it is to move the load vertically a short distance. The reason for this is that as an object is moved on a ramp it rests on a support which in turn rests on the earth. Thus the object does not need to be held up by the person at the same time that he is moving it. Therefore, the inclined plane is called a machine, because it enables a person to do work without expending as much energy as he would otherwise need to use.

Gradually through the years man has learned to make use of machines

rather than rely only on his own muscular effort. As a result, great changes have taken place in the cultures of the world. In fact, civilizations have risen through the use of simple machines. The inclined plane was used in many ancient well-advanced cultures including the Egyptian, Incan, and Mayan, as well as our own.

When a child uses a ramp he also has experiences with gravity. He works against gravity as he pushes his truck up the ramp. On the other hand, the pull of gravity greatly facilitates moving objects downward. As a child walks uphill he finds it more difficult than when walking down, because of the force of gravity. As will be learned later, gravitation is useful in every situation of life, not only when we are using an inclined plane or ramp. Gradually a child derives experiential learnings about this force which affects his daily living.

Ways of Working with Children

The children in your group may have used a ramp at some time to move an object from one level to another. They may not have been concerned with the amount of energy required to transport the load. Instead, they may have made the incline because it was appropriate for the particular play activity in which they were engaged. Possibly as they built with blocks and boxes or dug in the sand pile they were imitating operations involving ramps which they had observed at home or in the neighborhood.

By referring to *Science Near You,* such experiences of boys and girls may be extended so that ideas can be gained as to why people use ramps in carrying on their activities. Children might be stimulated to look for ramps and the way they are being used in various places. On the other hand, the book can be introduced for the purpose of alerting children to ways they themselves might use ramps as well as to ways other people use them. If attention is called to the difference in the amount of energy boys and girls require to carry on an activity with and without this machine, some understanding may be gained as to why ramps are prevalent in their environment, whether it is a rural or an urban community.

Pages 32–37 · A Way to Go Up and Down

Ramps make it easy to move things up and down.

Page 32 · The purpose of the illustration is to focus attention on the problem of taking wheel toys over steps, the energy and inconvenience involved, as well as a possible solution. Encourage children to recall similar experiences they have had. How did it make them feel to pull their toys over steps? What did they do to make their work easier?

Encourage the group to discuss how they think David must feel when trying to move his tricycle over the steps. How might they feel if they were trying to do it? Lead them to consider which parts of their body would be used and where their strength would come from.

Consider why Betty has stopped with her wheelbarrow. Why are Miss Mills and most of the children looking at the custodian? Speculate as to what he might be saying to the boys and girls. Why is he carrying the board? Such questions should stimulate a discussion which will point out the problem and lead children to anticipate how it will be solved.

Ramps make it easy to move things up and down.
Ramps make it easy to go up and down.

Page 33 · As members of your group discuss and compare the two situations illustrated in the book you will have an opportunity to help them analyze why the board makes it easy to move the equipment over the steps. Notice the length of the board in comparison to the distance over the steps. Speculate on how David might feel now in comparison with the way he may have felt when pulling the tricycle up and over the steps. Then read the text to find out what he said.

For fuller development of this concept, it is suggested that the children have a similar experience in attempting to lift, push, and pull equipment over steps. They need a muscular experience in order to learn about the energy expended by their muscles. Encourage several children to try pulling a wagon or doll buggy over steps, and later up a ramp. Do they agree with what David said? They should also have the experience of riding up a ramp in contrast to pushing a wheelbarrow up.

It is advisable for boys and girls to find out how ramps aid in transporting equipment down as well as up. In order to emphasize distance as a factor, a longer board also might be provided so that more striking comparisons can be made.

Ramps are useful not only in transporting loads from one level to another but also in making it easier for people to ascend or descend. To develop this meaning, encourage children to make comparisons by walking up and down steps and then going up and down a ramp placed over them. Ask the children to decide which is the easier way to go up and down. Lead them to think where they have seen people going up and down ramps and discuss the advantages of using ramps in those places.

Ramps make it easy to move things up and down.

Pages 34–35 · During their play, children may have occasions to set up ramps such as the one in the illustration. Ask the children what they think Ann's problem is. Why is David so concerned? Anticipate what

Ann and David might be saying to each other. Then read the text to find out. Prompt the group to imagine how Ann felt and why David knows an easy way.

To get an overview, suggest that the children look at all the illustrations on pages 34 and 35. Listen to their reactions. Are they speculating as to what will happen and what the children might be saying? Are they recalling their own experiences with ramps and making applications to this new situation? Do their interpretations reveal that they are gaining in ability to think in terms of space, energy, and the dependence of one condition on another?

Again it may be profitable for members of your group to have the actual experience of moving a loaded truck or some other wheel toy up and down an incline, just as Ann and John are doing. By running their trucks into and out of a sandbox with the aid of a ramp, they may have a runway or "road" which will facilitate their play and also give them actual experience with this simple machine. To emphasize the advantage of the ramp, encourage a child to demonstrate how difficult it is to get a loaded truck in and out of the sandbox. Then, for comparison, the same child might demonstrate an easier way by running his loaded truck up and down the incline.

Ramps make it easy to move things up and down.
Ramps make it easy to go up and down.

Page 36 · Observations in the neighborhood will reveal various situations involving ramps. In the construction of buildings many materials are moved up and down long planks by workmen. Moving vans have ramps so the loads can be moved in and out of the trucks easily. Farmers also need ramps for various purposes, such as loading animals into trucks or freight cars, driving into barns, and moving produce from one place to another. The page emphasizes that many adults use ramps, whereas in the preceding material children were using them. Be ready to provide boys and girls time not only to discuss what the men in the illustrations are doing and why the ramps help them, but also to recall where they have seen men using ramps in similar ways.

All these experiences may develop much interest and stimulate a desire to look for ramps at home as well as at school. The group might take a walk in the neighborhood or around the school plant and grounds to see if they can locate ramps. A sidewalk on a gradual incline and a street or highway on a hillside are ramps. A stairway is also an inclined plane which has steps on it. During their walk the children might interview the custodian, principal, or someone else who can assist them in locating ramps. They might ask these people how ramps help them in

doing their work. As a follow-up of this walk, records of their observations might be developed by painting pictures and dictating captions. When the paintings are framed and placed on the bulletin board with their captions, the meanings developed through other experiences may be reinforced. A list of ramps the children have seen being used might be recorded on a chart. From time to time additions may be made.

Page 37. Find Easy Ways to Go Up and Down · As children try to follow the suggestion given in the title they will have an opportunity to apply their learnings developed in relation to the use of ramps. They may refer to many of their observations and activities which helped them in making interpretations. To help summarize and apply their learnings, children might cut pictures of ramps from magazines and organize these on a chart or in a booklet. What readiness do they show to consider many facts before summarizing and drawing conclusions? Are they growing in their skill to generalize? Out of all the experiences suggested in this chapter, children may develop the idea that the ramp plays an important part in the lives of boys and girls and of adults.

Materials Needed

For use with *Science Near You*:

lumber, several wide pieces, one especially long
wheel toys

For use with Further Experiences:

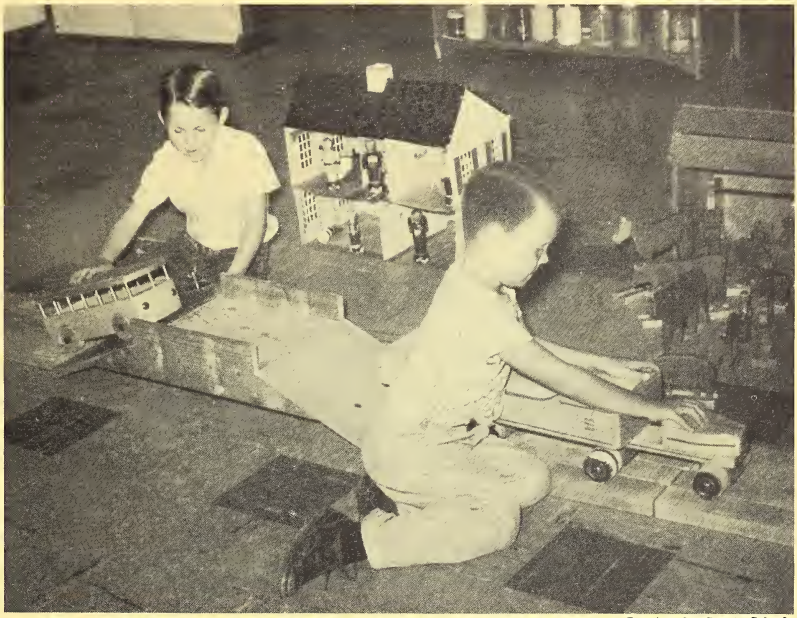
floor blocks
lumber, several pieces approximately 2″ × 8″ × 12′
overpass constructed of wood

Further Experiences

Walking up and down Inclines · Sometimes children like to walk up and down a board which is on an incline. Two or three pieces of lumber approximately 2″ × 8″× 12′ might be obtained for such a purpose. They should be fastened very securely on low substantial supports in order to insure safety. These can be placed in an arrangement a few inches off the ground so that children can go up one board, over another, and down the third board. Such an experience provides another opportunity for children to have the sensation of going up and down, which may make the situations illustrated in the book more meaningful to them.

Using an Overpass · Children frequently build inclined roads and streets with their floor blocks when they want to make an overpass. To extend their block play and encourage more use of ramps an overpass might be constructed with inclined approaches on both sides. (See the

photograph of two boys using an overpass.) They can run their cars and trucks up the overpass and down again, thus using the two ramps as they carry on their imitative play. This experience needs to be followed by a discussion in which the use of the ramps and their value are emphasized. Lead the children to tell where they have seen this kind of overpass in their community and to discuss how people were helped by it.



By introducing an overpass as shown here, children's imaginative play may be fostered and their concepts about the use of ramps extended.

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Evaluation

As the children carry on their play activities there are many opportunities to observe them apply what they have found out about this simple machine, the inclined plane. How are they using ramps? In what situations are they imitating some activity observed in the neighborhood? Which children comment about a ramp being helpful or suggest using one to solve a problem? Possibly some child will observe that this simple machine is part of a more complex one and express his ideas concerning the way it contributes in the operation. What evidence is there that individuals are gaining a feeling for the difference in amount of energy involved when objects are moved up and down over an incline, and when a ramp is not used?

Children's paintings may express ideas about use of inclines. Also

pictures of ramps may be brought from home thus revealing their interest in this machine. Spontaneous comments may be made as boys and girls look at books which show ramps in use. By listening to and observing a group of children, a teacher gains much information about the kind of concept formation being developed as well as clues to help her plan for extension of experiential learnings.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 688–692. Ginn and Company, 1958.

For the Children

Zaffo, George J. *The Big Book of Real Airplanes.* Grosset & Dunlap, Inc., 1951.

Zaffo, George J. *The Big Book of Real Boats and Ships.* Grosset & Dunlap, Inc., 1951.

Zaffo, George J. *The Big Book of Real Building and Wrecking Machines.* Grosset & Dunlap, Inc., 1951.

Zaffo, George J. *The Big Book of Real Fire Engines.* Grosset & Dunlap, Inc., 1950.

Zaffo, George J. *The Big Book of Real Trains.* Grosset & Dunlap, Inc., 1949.

Zaffo, George J. *The Big Book of Real Trucks.* Grosset & Dunlap, Inc., 1950. The six Zaffo books include large colored illustrations as well as text.

Zion, Gene. *All Falling Down.* Harper & Brothers, 1951. Beautiful, full-page colored illustrations and a small amount of text develop ideas about gravity.

VI

How Water Changes Things

Water brings about many changes. This chapter emphasizes the fact that some substances dissolve in water and others do not. Boys and girls may not be aware of this phenomenon even though their lives are constantly influenced by it. The water they drink and the food they eat are modified by the fact that some substances dissolve in water. It is equally significant that certain other substances do not dissolve in water, thus preventing numerous physical changes.

It is possible for boys and girls to have experiences which may stimulate questions and help them find out for themselves that some substances dissolve in water and others do not. Therefore, several situations are introduced in *Science Near You* to focus attention on how water produces certain changes. At home young children may participate with their mothers in cooking experiences and observe that salt disappears in water. Occasionally boys and girls have opportunities at school to prepare food, mix powder paints, and pour various substances into water. At such times their attention might be called to the fact that some things disappear, or dissolve, in water and that others do not. Such occasions might lead them to try out their ideas and through experimentation find out if soil, chalk, flour, and other materials disappear as do salt and sugar.

Watching substances dissolve in water challenges the thinking of young children. For instance, Jean sees her mother pour sugar on fruit when cooking it. Through a glass dish she observes the sugar disappear and questions what happened. In contrast, she notices that her mother uses many materials which do not dissolve. While experimenting with things that float Tommy sees a substance vanish and becomes curious. Gary puts his piece of candy in water and is surprised to find that some of it disappears. Numerous situations such as these provide children with diverse opportunities to learn about water changing materials as it dissolves them.

Science Meanings for Children

Various observations and considerable experimentation will give children a basis for drawing conclusions and making summarizing statements relating to the following science meanings:

Some things dissolve in water.
Some things do not dissolve in water.

The basic science pattern of change[1] involves these meanings. Children enlarge their concepts of change and make corresponding adjustments in their behavior as they find out that some substances change when water is added to them. Many of these substances change quickly; others change slowly.

Information for the Teacher

Boys and girls are affected by the way water dissolves some substances and not others. For example, the water they drink contains much dissolved mineral matter. Their food is modified by the way water dissolves some substances in it and not others. The body processes are greatly affected by the chemicals carried in water solution. Doctors prescribe certain medications which consist of drugs dissolved in water. Children may notice the difference in the taste of foods when sugar and salt are added. Sometimes they discover for themselves that sugar and salt disappear soon after being added to water.

This characteristic of water to dissolve some substances and not others is of great importance in the lives of all people. The chemist works with solutions while combining or separating substances. The pharmacist dissolves minute quantities of potent drugs in water so that these can be administered safely to patients. Doctors study substances dissolved in water and their effects on body functions. The person who processes foods deals with solutions and needs much knowledge of the way in which water dissolves certain substances. It is evident to the plumber that water dissolves some materials and not others when he is called upon to make repairs. The laundryman utilizes such information to help him carry on his work. The nurseryman also makes use of this phenomenon. Plants use water containing many substances; therefore, the nurseryman can affect their growth by adding nutrients dissolved in water. He knows that water dissolves soil minerals which are taken in by plants through their root hairs.

When a substance dissolves in water, a solution is formed. Sugar completely disappears when dissolved in water and therefore a solution

[1]For further discussion of the pattern of change, see the Foreword, pp. xviii–xix.

results. It tastes sweet no matter whether the sample is taken from the top or the bottom of the solution. After the sugar has dissolved, it will not settle to the bottom. The sugar particles have spread throughout the water and remain that way. Salt, too, dissolves and disappears in water. Only by tasting the water, is it evident that salt is there. Some substances dissolve in water more easily than others. For example, sugar is very soluble in water, salt is fairly soluble, and chalk is almost insoluble.

What takes place when substances dissolve in water? Water is made up of tiny particles called molecules. These are always in motion because they are free to move about. Sugar, salt, and other substances also are made up of molecules. When the molecules of soluble substances break away from each other and move among the molecules of water they are said to dissolve. If the substance is colorless, the solution will not change in appearance.

Ways of Working with Children

Science Near You provides an opportunity for children to carry on various activities in relation to the way water changes some things. The book may be used to introduce several experiences to boys and girls and encourage their participation. However, if they already have developed an awareness of this change, you may wish to use this chapter to further their activities and learnings.

Pages 38–41 · How Water Changes Things

Some things dissolve in water.

Page 38 · When listening to children discuss the illustration you may hear reactions which offer valuable leads for developing the meanings involved in the chapter. Encourage sharing of impressions gained during a cooking experience. Lead the children to tell what happened when they poured something into water. Motivate them to speculate about what happens as David pours sugar into the lemonade.

When sugar dissolves in water, it becomes completely invisible and makes the water sweet. Boys and girls may not have watched it dissolve but, of course, they have often been aware of the resulting change in taste. Plan with them to make lemonade or some other fruit drink. Then they can have different sensory experiences when adding sugar to water, watching it dissolve, and tasting the change in flavor.

Some things dissolve in water.

Page 39 · Anticipate what Betty, Mary, and David say as they make lemonade. Read to find out what Betty said to Mary and David while

they were drinking the lemonade. With emphasis on the science meaning, encourage a discussion of the conversation developed in the text. Lead the children to recall sensations they have had when adding sugar to a drink.

Motivate the children to discuss the title of the chapter. Do they draw upon their previous experiences in telling how water changed something other than sugar? Lead them to wonder about other things that might be dissolved in water.

Some things dissolve in water.
Some things do not dissolve in water.

Page 40 · The illustrations may prompt children to recall observations they have made when watching their mothers cook. They may have noticed sugar or some other substance dissolve in water. Out of such a discussion it might be advisable to help them make a list of all the things which they think will dissolve in water and record these on a chart. From time to time the list might be extended.

Offer guidance in reading the text to find out about David's observations and to gain an explanation of what happens to salt in water. If the children have had an opportunity to use the terms *dissolve* and *salt* in their discussions, they may be able to read the text easily.

Motivate the boys and girls to tell about some things which did not dissolve as they observed their mothers cooking. As they speculate about other things they think will not dissolve in water these substances might be listed and placed on a chart for later reference.

In order to check their speculations, it will be necessary for the children to test their ideas by experimenting. Encourage the use of materials such as sand, pebbles, sticks, leaves, paper, cocoa, rice, paste, and calcimine paint. As a result of this planning, speculating, experimenting, and reading, the group will have a better background for making interpretations on page 41 of the textbook.

Page 41. Experiments for You · The page emphasizes the importance of providing opportunities for experimentation so children can discover facts for themselves. It is one thing to see granulated sugar dissolve in water and another to find out that loaf sugar will also dissolve. Mary, David, and Ann are doing different experiments to emphasize the importance of performing several experiments before drawing conclusions.

After members of your group have planned and carried out their experiments, you might help them check their charts about things that will and will not dissolve in water. If they have not used salt, sugar, and flour, they might do so in order to verify their results with those obtained by Mary, David, and Ann. They should find that flour will not dissolve, but that loaf sugar and salt dissolve readily.

As a result of such experiential learnings, children may make interpretations and be able to answer the questions: Which things dissolve? Which thing does not dissolve? Page 41 in *Science Near You* helps boys and girls summarize their learnings. After a variety of experiences, your children may have drawn the following conclusion: Some things dissolve in water, but many things do not.

Materials Needed

For use with *Science Near You*:

bowl
calcimine paints
cocoa
flour
flour sifter
glasses
granulated sugar
leaves
lemon
lemon squeezer
loaf sugar
measuring cup
paper
paring knife
paste
pebbles
pitchers
rice
salt
sand
spoons
sticks
water

For use with Further Experiences:

glasses
salt
spoon
water

Further Experiences

Stirring to Hasten Dissolving · Add salt to two glasses of water. Stir the salt in one glass. Leave the other undisturbed. The stirring makes the salt dissolve faster.

Discussing and Observing Other Changes · Refer to the title of the chapter and consider other ways water changes things besides dissolving them.

Evaluation

Some changes in behavior may be observed as children increase their participation in discussions, make observations, and thoughtfully experiment with materials. In what ways are children becoming more resourceful and responsible in their behavior? They may show that their concepts are being deepened concerning the way water changes things. In what way are they becoming more critical in their thinking? Do they question magic as a cause for the disappearance of substances in water?

How do children show that their concepts of the large pattern of change are expanding? As children think about the title of the chapter some of them may discuss ways in which water changes things other

than by dissolving them. If so they may be developing more awareness of changes around them.

A few children may tell about carrying on some of the same activities at home that they did at school. If so, they evidently considered these experiences sufficiently worth while to do them during their leisure time. You may observe several children continuing this interest after the group has become involved in other activities. Such behavior indicates that the experiences have held significance for them.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 437–500. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition. Wm. C. Brown Company, 1955.

For the Children

Podendorf, Illa. *True Book of Science Experiments*. Childrens Press, 1954. Simple science experiments for children. Includes several experiments with water.

VII

Air Around You

The earth's atmosphere is taken for granted by most people. They live in it, move in it, use it in endless ways, and modify their activities because of it. Nevertheless, they may know little about this ocean of air that surrounds them. The atmosphere completely envelops the earth and extends a considerable distance beyond its surface. Therefore, many phenomena involve air and can be explained through learning about principles relating to it.

Young children frequently ask questions about air. For example, Why do we feel air push? Why can we not see air? Where is air? Why is air always around us? It is possible for boys and girls to make observations and do experiments which give a basis for interpreting conditions around them. Therefore, suggestions are given in the book to help children gain ideas which may serve them in adjusting to their environment.

The everyday experiences of a child help him find out that air surrounds him. He likes to run and feel the force of air against his body. Sometimes he must run after his cap or a paper which the wind blew away. Possibly he experiences the movement of sailboats on a lake or attempts to sail his toy boat. He observes the movement of kites, leaves, and branches of trees, as well as moving smoke and clouds. Sometimes he notices just a slight quivering of leaves. During much turbulence he may observe the whole tree swaying. At other times he may not be able to see any evidence of air. However, even though he cannot see things move, air is constantly in motion.

Questioning may result from a child's observations and lead him to do experiments and try out his ideas. Perhaps he makes wind with his hand, a piece of cardboard, or a fan. Sometimes children like to hold a ribbon, string, piece of paper, or pin wheel in a breeze to observe movement. As boys and girls carry on these activities they find out something about this form of energy and how it becomes a strong force at times.

Besides leading children to observe evidences of air around them and to find out that it can make things move, the book introduces experiments boys and girls can do to show that air is in containers. It is possible for people to use air by inhaling it, by compressing it to exert pressure, or by forcing it into containers like balloons and tires, as shown in the book. Children can have various experiences while finding out that air can be forced in and out of containers. They learn that air can be used to do work.

Science Meanings for Children

The following meanings are developed in the chapter:

Air moves.
Air is around you.
Air moves things.
Air is in some things.
Air can be put in some things.

Even though a child moves in air, inhales it, and uses it in other ways, his concepts about air may be very limited. The purpose of this chapter is to guide the young child in extending his awareness of air around him, arouse his curiosity about it, and help him in making interpretations concerning this form of energy. Gradually he may develop concepts involving the basic pattern of change as he learns how air changes and the way people can cause some of these variations. Ideas about the vastness of space might be extended as he becomes aware of the air around him at home, at school, and in more distant places. Besides these learnings boys and girls may enlarge their concepts concerning energy as it is related to ways people use the force of air to help them in their activities. For further treatment of these basic patterns of change and space, you may refer to the Foreword.

Information for the Teacher

A baby, as well as an adult, has experiences with air. It surrounds him from the time he is born. He inhales it and moves about in it, but he is not aware of its presence. The four-year-old likes to run against the wind and feel it pushing against his body. He runs with his pin wheel to see it spin and plays with his balloon. The six-year-old feels the force of wind, hears it blow, and sees smoke and clouds move because of it. However, he may not realize that these conditions

are due to the movement of air around him because he can neither see nor touch it. Some children may raise questions and show a readiness to try out their ideas and find out how, where, when, and why. They may have found out that they can blow air into a paper bag or make wind with their hands. They may have learned that there is air in containers which appear to be empty.

In order to work with boys and girls, a teacher may wish more information about the atmosphere. Some of the following facts may be helpful in guiding children as they attempt to solve their problems and find answers to their questions. Others may be useful only to add to the teacher's background regarding certain aspects of the topic.

The atmosphere completely envelops the earth. It is constantly held close to the earth by the force of gravity; therefore as the earth moves in space its atmosphere moves with it. Because of gravity, air is in the classroom, in drawers, and in "empty" bottles, cans, and boxes. Air enters buildings. It penetrates the soil. It goes down into deep mines. Air presses into and fills every space. It extends far out into space.

Scientists are continuously carrying on research to learn more about the content and extent of the atmosphere. They find that it is densest at the earth's surface owing to the force of gravity. The air is exceedingly thin far from the earth's surface. Scientists do not know how far air extends out from the earth. However, they definitely know that it extends at least 600 miles. They think that a rarefied atmosphere may even continue to a height of 10,000 miles. The weight of the atmosphere produces much pressure on the earth.

Frequently evidences of air in motion can be observed. The leaves flutter a bit, smoke shows a slight deviation, and clouds gradually change position. Sometimes air moves so rapidly that trees sway, doors bang, dust whirls, papers scatter, and tumbleweeds bounce over the land. Occasionally the turbulence is so great that trees are felled and buildings blown down. Air can develop tremendous force and move things.

This movement results from unequal heating and cooling of the air. When heated, the small particles of gases, called molecules, move very rapidly; therefore the heated air expands. As it does this, of course, it becomes lighter in weight, with the result that the surrounding heavier air pushes it upward. Such action causes a downward movement of heavy cold air rushing in to replace the rising warm air. A mass of cold air may push under a mass of warmer air. A mass of warm air may be forced up and over a mass of cold air. When there are extremes in the amount of heating and cooling, a great turbulence develops. The constant variation in cooling and heating accounts for the difference in wind speeds. Air is always in motion because of this variation.

Air has many uses because it can be forced into containers and held under pressure. Cars, trucks, and airplanes are supported by air in tires. The machines which have been developed to compress air make it possible for people to use it in brakes, hammers, drills, and other tools and machines. Children sometimes force air into paper bags, balloons, and balls, as well as into their bicycle tires. Because air can be put under pressure, people find numerous ways of using it to help them in their activities.

Ways of Working with Children

"Air Around You" might profitably be used when the children are especially concerned with some aspect of air. At such a time they will have set up a definite purpose for gaining information from the book. On the other hand, you might introduce the chapter to stimulate their thinking about air and to explore new ideas. Also, many times young children share simple air experiments which they have learned elsewhere. Your group might begin this chapter through questions concerning such an experiment.

Pages 42–49 · Air Around You

Air moves.
Air is around you.

Page 42 · The illustration may prompt your children to recall similar experiences they have had. They might tell about their observations of kites flying in the wind. Jimmy might refer to times when it was impossible for the big boys to fly kites because there was no wind. Helen may recall things she saw move, such as trees, bushes, grass, flowers, and papers. The movement of the clouds may have been noticed by Bob, who raises the question, "What makes the clouds move across the sky?" Lead the children to discuss the illustration by telling what makes them think air is around Ann, David, and the other children.

Sensations experienced on a windy hillside may prompt a child to tell about the wind blowing his cap off, or pushing him uphill, or making him cold because it blew so hard. How did he feel another day on the same hillside when the wind was not blowing? Such a question might lead the children to wonder if air is around them when the wind is not blowing.

Suggest that the boys and girls paint pictures of a situation they have encountered on a windy day and thus help them to go beyond their word pictures. A discussion of the finished paintings may encourage them to make many more observations, paint additional windy day pictures, and ask questions about the evidence of air around them.

Air moves.
Air moves things.

Page 43 · The movement of the sailboats gives further evidence that air is in many places. Children who live near a large body of water may have seen sailboats and be ready to tell how they move. Experiences they have had when sailing toy boats may lead to a discussion of what makes them go and of what conditions are good for sailing. Motivate the boys and girls to anticipate what Mary, David, and Father might be saying. Encourage discussion of the explanation given in the text.

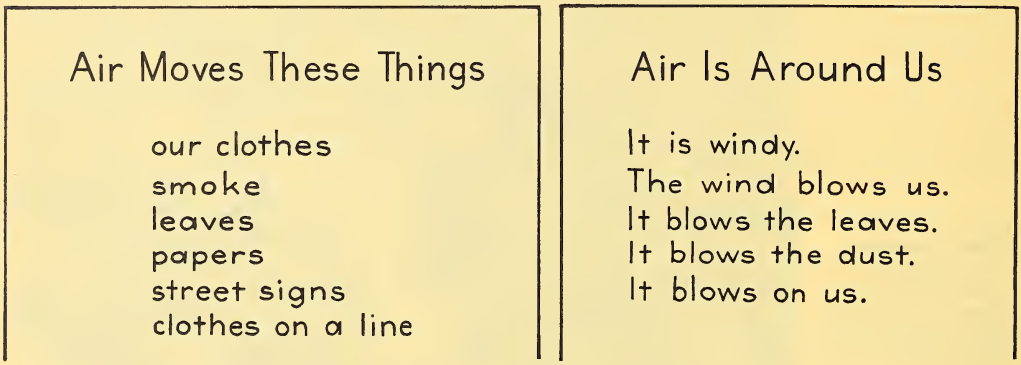
Children need opportunities to speculate and make predictions, and then to test their proposals or hypotheses in order to clarify ideas and gain depth in their learnings.

Los Angeles County Schools

Boys and girls should try the experiments at the bottom of the page, as well as discuss the illustrations. They can make air move by using cardboard, paper, a book, a fan, or a hat and feel the sensation of moving air on their faces. They might fan each other or stand in a windy place. Watch their spontaneous behavior and resourcefulness as they try to move air. What are their proposals? Do they look for further evidence? What conclusions are they making about air? Encourage the children to have an experience similar to that illustrated by Mary. One child might use his paper fan to move something held by another child, such

as a piece of cloth, a ribbon, or a sheet of paper. Something might be held in the window or the doorway, or taken outdoors to demonstrate that air is around them. Again encourage resourcefulness as you guide the children in concept formation.

When taking walks or looking out the windows, many situations may give evidence that air is around houses, in the schoolyard, on the hillside, and around the boys and girls. Children might cut pictures from discarded magazines showing evidence of air and organize these on the bulletin board. It may be desirable to help them make records on charts, such as the ones shown here. Children's paintings of a windy day might be used on the charts.



Air is in some things.

Pages 44–45. Betty's Experiment · The sequence of pictures on the two pages illustrates the use of an experiment in solving a problem. Emphasis is given to questioning, observing, and listening to explanations. For children to develop the concept that air is in the glass, they should have an opportunity to do the experiment themselves. As a result, ideas for other experiments may emerge. For instance, if the glass of air is tipped a bit to one side in the water, air bubbles will come to the surface. This will prove that there was air in the glass. They might push a crumpled piece of paper into the glass and then place it in water upside down to show that air prevented the paper from getting wet.

Children should look at all the pictures at one time and in sequence so that they will have an over-all view of the situation. Encourage them to discuss what they think is happening in each illustration. Do they question magic as an explanation for the cork going to the bottom of the dish? Do they show a readiness to do the experiment and find

out for themselves what happens? Assist them in reading to gain an explanation and check the accuracy of their proposals.

When the children do experiments, it is important that the results be checked or verified. Frequently the wrong conclusion may be drawn because the experiment is not done accurately. Children may verify their results with those shown in the book.

Air is in some things.

Pages 46–47. Experiments with Air · Frequently an experiment prompts questioning and results in the need for another experiment. After finding out that a seemingly empty glass contains air, questions may arise regarding air in other containers. Speculations might be made as to where there is air in the classroom. Sometimes children do not think air is in dark places, such as a cupboard, drawer, closet, or box.

To help solve such a problem, encourage children to try the experiments shown in the book. For the experiment on page 46, they will need to make a nail hole through one end of a closed box and paste on the box narrow tissue streamers so that they hang down over the hole. Then press on the box quickly. Visible evidence of the escaping air will be seen in the moving streamers. If the children verify their results with the textbook, they can determine whether or not they are doing the experiment accurately. Are they questioning magic as an explanation of events? Are they changing their ideas as a result of new evidence?

The situations on pages 46 and 47 not only illustrate how an experiment may develop from the results of a previous one but they also emphasize how adults may guide children to find out for themselves by using materials in their environment. After doing many experiments, boys and girls may draw the conclusion that experimenting is a good way to obtain information. They might develop much resourcefulness in suggesting experiments to help solve a problem.

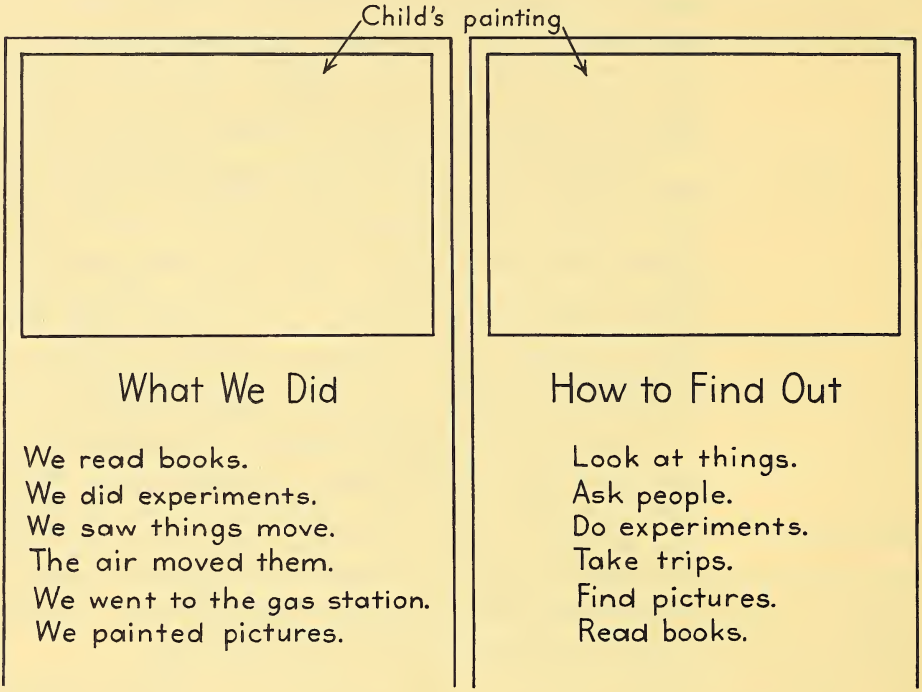
Air can be put in some things.

Page 48 · Air can be forced into containers and thereby serve many purposes. Children may have observed bicycle and automobile tires being inflated with air. Undoubtedly they have forced air into paper bags, balloons, and other containers. The illustrations on the page may help children recall similar experiences they have had and lead them to try these kinds of activities. They might invite an older child to demonstrate how a ball can be inflated with air. In order to have the sensation of forcing air into the ball, they could help him by using the pump.

If there is a gasoline service station within a short walking distance, you might wish to talk with the manager and find out if it would be possible for your group of children to visit the station. This would give

them an opportunity to see the attendant put air in an inner tube or in a tire which is on a car, truck, or bicycle. He might give them an opportunity to feel the air pressure as it comes out of an inner tube or air hose. Such an experience emphasizes the science meaning, air can be put in some things.

Page 49. How Do You Know Air Is Here? After having many experiential learnings concerning air, boys and girls will have a background



for interpreting the illustration. Thus they will be better able to summarize their learnings about air and come to some conclusions. When helping children draw conclusions, you may wish to have them turn back in the book and look at all the illustrations in the chapter. As they do so they might determine which ideas are also developed in the concluding picture. They might decide which lines of text on the page could refer to illustrations on other pages. As a result, they may gain the idea that the last page includes ideas given on all the pages concerning air.

It might be profitable for the group to summarize the activities they have carried on in finding out about the air around them. If this summary is on a chart, it will give emphasis to ways of working and to the idea that information can be obtained in many ways. The chart "What We Did" illustrates a possibility. Another chart, "How to Find Out," might evolve as a result of several experiences the children have had in summarizing their activities. Such a chart might be used for reference later when the children plan ways of solving some of their other problems. The charts are only suggestions. You and the children may think of other forms for such records when you plan together.

Materials Needed

For use with *Science Near You*:

- air pump
- ball, to inflate
- balloon
- bottle
- bubble pipe
- calcimine paints
- cardboard
- cardboard box
- containers for water
- cork
- crumpled paper
- drinking glass
- electric fan
- newsprint, 18" × 24"
- paste
- pictures from magazines
- piece of cloth
- ribbon
- scissors
- sheet of paper
- soap
- tissue paper

For use with Further Experiences:

- paper bags

Further Experiences

Observing Condition of the Air · Encourage children to look out the classroom windows on different days to observe the condition of the air. How far can they see? Can they see farther on one day than they did on another? Do they conclude that something in the air, such as dust, smoke, or fog, sometimes prevents them from seeing so far?

Using Air Pressure · A child might blow into an empty paper bag and see it swell with air. Then with one hand holding the top of the bag tightly shut to keep the air inside, he can feel the firmness of the bag with the other. He can feel the pressure of the air inside the bag. Have him hit the bottom of the bag and burst it. Does he understand that hitting the bag exerted extra pressure on the air inside and caused the paper to burst?

Evaluation

From time to time you and the group will be assessing progress in order to determine next steps. Questions such as the following might be asked: How are we improving in the way we work? What helps us improve? What have we found out about air? What do we do next? Taking stock of their participation in different activities helps children think through their behavior and clarify purposes.

Particular growth on the part of some children may be observed as they show resourcefulness in making certain observations of air around them and in their ways of finding out about it. Several individuals may begin to assume more responsibility for the work of the group as well as for their own behavior. Perhaps greater depth in concept development is noticeable on the part of some children. As you study the changing behavior of the group there may be evidence that several boys and girls are gaining skill in predicting events, anticipating what might happen, or, in other words, setting up hypotheses. How resourceful have they been in testing their ideas and drawing conclusions?

High value is placed on continuity of children's experiences. At different times throughout the year there will be opportunities in classroom daily living for children to find out more about air and apply their experiential learnings to new situations. Concepts concerning the earth's atmosphere may be deepened and extended from year to year as children use the other books in this series, SCIENCE TODAY AND TOMORROW.

Bibliography

For the Teacher

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 179–195. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 392–459. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition. Wm. C. Brown Company, 1955.

For the Children

Podendorf, Illa. *True Book of Science Experiments.* Childrens Press, 1954. Simple science experiments for children. Includes several experiments with air.

Film

BLOW, WIND, BLOW. (Cor) 1 reel, color and b/w. The story about wind is seen through the eyes of Johnny.

VIII

The Sky

The sky seems like a great dome or ceiling which extends over our heads and down to the horizon. Sometimes it seems to be far above the earth. Sometimes in foggy or stormy weather it appears much closer.

We live under a sky which is constantly changing. The morning sky with the sun in the east is very different from the noonday sky or that of evening when the sun is setting. Some days the sky is overcast; other days are sunny with few clouds in sight. Frequently there are many changes in cloud formations throughout one day. At one time the clouds may be high and fleecy; at others they may be white and billowy. Later in the day there may be dark, low, rain clouds. Besides the changes in cloud formations, the sun appears in different positions in the sky throughout a day. Also there is the great contrast between the day and night skies. The night sky too varies in many ways. It also has a variety of clouds, various phases of the moon, and endless variations in the number of visible stars.

Life on the earth is greatly modified by these changes which affect the amount of light, temperature, precipitation, and movement of air. On cloudy days a child often needs warm clothing; on sunny summer days he needs little clothing of any kind. A stormy sky may modify a child's activities considerably. The lightness of the sky is a factor in determining the time he goes to bed at night and gets up in the morning. In general, people adjust their daily activities to conditions caused by these changes. Because the sky plays a definite part in the life of a child, he needs guidance in making interpretations of it and help in adjusting to the changes he sees and feels.

Situations in *Science Near You* focus attention on storm clouds, rain, and formation of a rainbow. When the storm clears, as shown in the illustrations, the sky becomes sunny and blue again with a few white clouds. Later the moon comes into view and can be seen even though the sun is also in the sky. These changes are followed in the book

by illustrations showing a sunset and variations in the way the sky appears on different nights.

Through discussion of these situations and their own observations, boys and girls may extend their ideas about the changing sky. Use of *Science Near You* may prompt them to ask questions and help them clarify their concepts.

Science Meanings for Children

The following science meanings are developed in the chapter and may help in guiding the learnings of children along the large basic patterns of space, time, change, and variation:[1]

The day sky changes.
The night sky changes.

As boys and girls observe the sky they may gradually begin to summarize their ideas about the way it varies from day to day and from night to day. Concepts of time may be expanded while concentrating on the movement of clouds, or the length of time it takes for the position of the sun to change from being high overhead to low on the horizon, or the number of days the moon can be observed in the daytime sky. Children's ideas may be changed in reference to the vastness of space as they make observations and become concerned about the sky. The moon and sun may seem very small to them in comparison with things they observe on the earth. Even though concepts of these science meanings are difficult to develop, young children may become acquainted with the very beginnings of the ideas as they focus attention on the sky.

Information for the Teacher

At an early age some children show an interest in the sky. Even a two-year-old may call attention to a sunset or a rainbow. From her porch a three-year-old looks for a bright star in the evening sky. Another child exclaims over the big yellow moon he has seen. Young children become attracted to the way the sky varies from one time to another and begin to ask searching questions.

Frequently, when the sun is rising or setting it produces dramatic effects on clouds about which a child may be inspired to comment. Possibly he is intrigued with a rainbow and asks questions about it. Six-

[1]For further discussion of these patterns, see the Foreword, pp. xv–xix, xxi–xxiii.

year-olds wonder about the moon. Why do they sometimes see it in the daytime? Why does it have different shapes? The night sky also stimulates their thinking. They wonder why it becomes dark and where the sun is. Why does it shine only during the daytime? Why do they see the moon some nights and not others? When boys and girls indicate by their questions that they are interested in the sky, they offer a challenge to adults to provide experiences which will help them answer their questions.

The following information may be useful as background for a teacher while developing the science meanings about the day and night sky. Additional material is included in the references given at the end of this chapter.

The sun shines all the time and gives out light in every direction. People sometimes say that the sun is not shining on a cloudy day. Of course, they mean that they cannot see it because of a thick ceiling of clouds. On a cloudy day it is possible for people in an airplane to fly above the clouds and find that the sun is shining even though they could not see it when they were on the ground. At night the sun shines on another part of the earth when our half of the planet is turned away from the sun. During the night, people are within the shadow of the earth.

Even though boys and girls may think the sun is very small, it actually is gigantic. It appears small only because it is a long distance from the earth (93,000,000 miles). As children stand next to the school bus it seems very large; when seen from a distance it appears much smaller. Likewise, the sun seems small to them because they are so far away from it. Actually, the diameter of the sun is 109 times the diameter of the earth.

Sometimes the moon can be seen in the daytime sky and at other times in the night sky. This is due to the fact that the moon travels around the earth as the earth, in turn, revolves about the sun. Because of the time the moon takes to move around the earth, it rises and sets about fifty-one minutes later each day, which means that sometimes it is observed during the day and sometimes at night.

We can see the moon only when light from the sun is reflected from it toward the earth. At one period during the moon's revolution around the earth we see a full moon. Most of the time only a crescent of the moon can be observed. This is due to the fact that as the moon goes around the earth varying amounts of its sunlit hemisphere are visible on the earth. These lighted portions are known as phases of the moon. Sometimes all the lighted portion is turned away from the earth, and then we cannot see any of the moon. Although the shining moon appears

small to us, it too is very large and only looks small because it is a great distance from the earth.

Clouds can change rapidly. The wind pushes them across the sky with a speed that alters their form as well as their position. Some clouds form high in the sky while others build up in the lower atmosphere. Clouds vary in many ways. They may be white and fleecy, large and billowy, gray and in continuous layers over the sky, or dark and formless storm clouds. They may be composed of tiny drops of water or, if high in the atmosphere, they may contain crystals of ice. Sometimes dramatic effects are produced as rays from the sun shine on cloud formations at sunrise or sunset.

Another spectacular change in the sky is the rainbow. It is produced when the sun's rays pass through raindrops. Each of the colors which make up sunlight is bent as it passes through a raindrop in such a way that a rainbow is projected against the sky. Therefore, a rainbow can be seen only when the sun is near the horizon so that sunlight can shine through raindrops and cast the colors on the opposite part of the sky.

Streaks of lightning momentarily transform the appearance of a day or night sky. They are great sparks of electricity. In a thunderstorm raindrops become charged with electricity. Lightning occurs when there is a discharge of this electricity between the bottom and top of a cloud, or between two clouds, or between a cloud and the earth.

Various changes can be observed in the night sky. On a clear night when there are no clouds, many stars can be seen. Some shine brightly, and others are faint. Many of them are so far away that they cannot be seen with the naked eye. Stars appear minute because of their tremendous distance from the earth. Our sun is a star of only average size. It looks large to us in comparison with the stars of the night sky only because it is so much closer to the earth than any of the other stars. Besides the clouds and stars, the moon and one or more of the planets are sometimes seen in the night sky.

Ways of Working with Children

The chapter might be used to introduce a discussion of the sky, stimulate observations, and lead to making interpretations about some of the changes children see. Boys and girls may offer excellent leads into the use of *Science Near You* through experiences they have had. Also, since the material is about David's trip to the mountains, the chapter might be introduced when your children have been discussing their vacation activities or trips. Or it might be used in connection with their experiences relating to weather.

Pages 50–55 · The Sky

The day sky changes.

Page 50 · Encourage children to recall and tell about their experiences in a rainstorm. Prompt them to emphasize the appearance of the sky before, during, and after the storm.

Consider the drama of sudden changes in David's experience as he and his mother and father are vacationing beside a mountain lake. Help children interpret the overcast condition of the sky during this sudden storm. Call attention to the dark clouds. Observe the rain and evidences of wind that accompany the storm. How does the rain affect the activities of the people? How might David feel?

The day sky changes.

Page 51 · What kind of sky does David see as he stands in the doorway of the cabin? How has it changed since the rain started? Read the text to find out what David said. Discuss his comment and anticipate how the sky might look later.

What are your children's spontaneous reactions to the rainbow in the picture? Lead them to think of the time when they saw a rainbow. Was it before or after a rainstorm? Encourage them to keep this question in mind the next time they see a rainbow. Offer opportunities to express their ideas by painting pictures.

Ask the children to read to learn what David finds out about the sky. They might discuss his impressions as well as similar observations they have made. Lead them to think of different ways they have noticed the sky change other than those given on pages 50 and 51.

You may wish to jot down comments which are made about different ways children have noticed the sky change. If these are recorded on a chart so children can read them, additions might be made from time to time as other changes are observed. Another way to center attention on the changing sky is for children to cut pictures from discarded magazines and arrange these on charts to illustrate the kind of sky they have seen on a rainy day, sunny day, windy day, or other kinds of days.

The day sky changes.

Page 52 · Prompt boys and girls to look at both situations illustrated and focus on the variations in the sky. How does the sky appear after the storm when David is able to go outdoors and play with his boat? How has it changed a short time later when David's father and a friend have joined him? How does this difference in the sky affect the activities of these people? Through discussion an interest might be developed in making further observations of the sky.

The day sky changes.

Page 53 · When relating their experiences, have the boys and girls mentioned the sky of the early morning or late evening? Have they referred to the moon or the setting sun? The illustrations focus on the morning sky at a time when the moon is in view as well as an evening sky that includes a dramatic sunset. The part of the moon which is visible faces the sun, thus showing that the moon reflects light from the sun.

When looking out the classroom windows, the children will see many changes in the sky. If they go outdoors to a good vantage point, they can observe a considerable amount of the sky. This should be done a number of times to help them develop the concept that the sky varies from day to day and from hour to hour. They might paint pictures of the sky to record their impressions.

Also help the children anticipate observations they might make at home in the evening or early morning. Plan for time the next day to report what they see. Some children may not participate much at first, but they may offer contributions at a later time which show they have been reacting inwardly to many situations. Boys and girls need time to ponder and think through their ideas before communicating them to others.

The night sky changes.

Page 54 · The emphasis given to the daytime sky might also prompt some boys and girls to notice changes in the night sky. Encourage them to discuss what they see. They may observe that there are many stars and that some are brighter than others. They may see the moon in its various phases and note that the full moon produces much light. Bobby, for example, may comment about not being able to see the stars some nights. This may stimulate Joan to question the reason and lead all the children to make further observations. Later they may draw the conclusion that clouds can be in the night sky as well as in the daytime sky. Various experiences such as these should establish a background for interpreting the text and lead to the development of the meaning that the night sky, as well as the daytime sky, changes.

Page 55. What Changes in the Sky Do You See Here? To assist children in summarizing their experiential learnings regarding the changing sky, several illustrations are shown. The situations depicted are similar to the ones used previously. Therefore children will have a background for interpreting them and answering the question, "What changes in the sky do you see here?"

It might be helpful for the boys and girls to summarize their learnings in more than one way. By referring to all the records they have made of the changing sky on charts and in paintings, they will have an oppor-

tunity to draw upon much evidence. Similarly, if they have made many observations of the sky and entered into considerable discussion about conditions they have seen, boys and girls may be ready to draw conclusions and summarize their ideas.

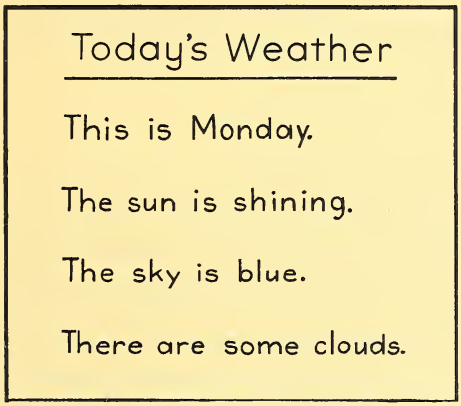
Materials Needed

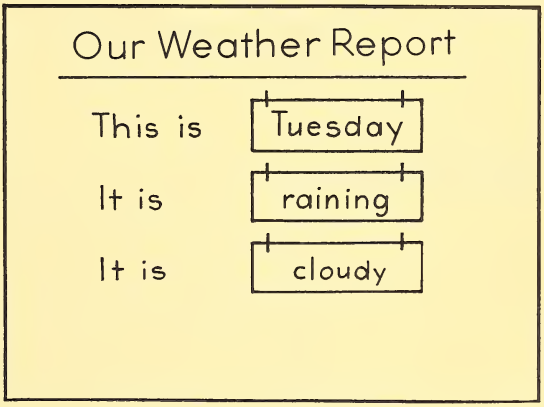
For use with *Science Near You* and Further Experiences:

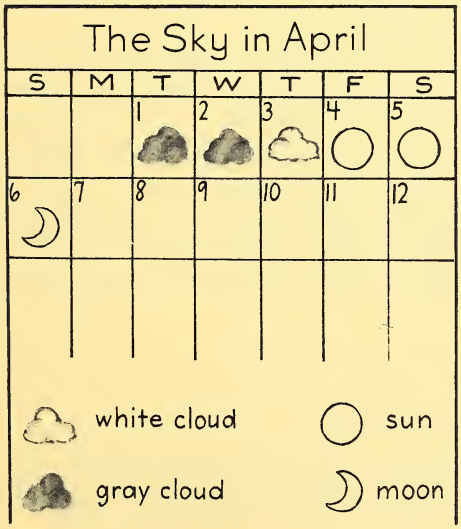
calcimine paints newsprint, 18″ × 24″ pictures

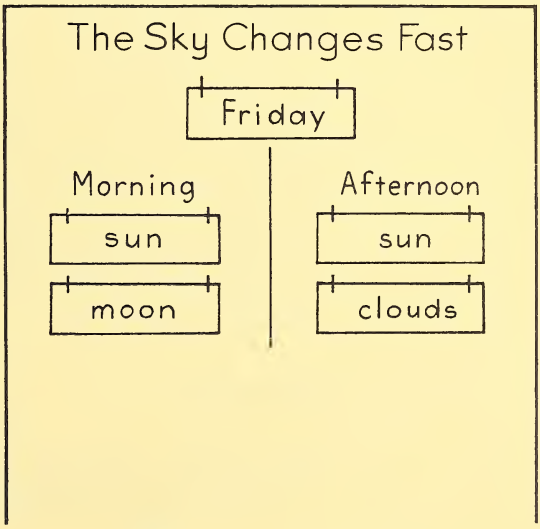
Further Experiences

Keeping a Daily Record of the Daytime Sky · It may be desirable to help the children keep a daily record of observations they make









of the daytime sky. This may be done in a variety of ways, including making charts such as those illustrated on page 107.

It may be advisable for boys and girls to keep one type of record for a few days and then vary the procedure. If the record is kept on a calendar, several children might take the responsibility of observing the kinds of weather occurring during week ends in order to have a complete record for the week. Perhaps a child's painting on the weather chart might help to center attention on the changing sky and re-enforce learnings.

As you plan with the children they may have suggestions for recording their observations. For instance, someone might suggest painting a picture of the sky as it appears when he arrives at school. During the next few days other children might do the same thing. If these pictures are mounted on the bulletin board with captions giving the day of the week, the children will have a picture record of the sky during the week for a definite time of day.

Evaluation

When studying the behavior of your children, you will observe that they vary greatly in experiential learnings about the sky. Some boys and girls may have more readiness for observing and discussing these changes than others whose attention may have just been alerted through these experiences. In what ways are individual needs being met? You may observe a changing attitude or behavior on the part of one child which is very significant for him at his particular stage of development. Another child may show concept development which is far beyond the capacity of many children in the group.

It is through experience that interpretations are made by children. How freely do they call upon their past experiences concerning changes in the sky and share these with others? Which children participate in a number of activities carried on by the group? Through different experiences there are opportunities to develop an awareness of the changing sky, create a questioning attitude, and extend learnings. Your children may have made comments showing that they have expanded their ideas about the sky and, also, that they are becoming more aware of such changes from day to day.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition. The Sun, pp. 193–203; The Earth's Moon, pp. 218–222; The Water in the Air, pp. 437–451; Sunlight and Color, pp. 797–800. Ginn and Company, 1958.

For the Children

Tresselt, Alvin. *Rain Drop Splash.* Lothrop, Lee & Shepard Company, Inc., 1946. Through attractive illustrations and poetic text, concepts are developed about rain from drops to puddle, pond, brook, lake, river, and sea.

Zolotow, Charlotte. *The Storm Book.* Harper & Brothers, 1952. Beautiful illustrations and rhythmic prose portray the effect of an electrical storm on people in the city and country, on field, ocean, and mountain, in such a way that a child might sense its beauty.

IX

Rocks Near You

Rocks are among man's important natural resources. He uses them in retaining walls, in dams, in construction of bridges and buildings, for roadbeds, and in concrete for highways. Rocks also serve ornamental purposes as well as numerous utilitarian uses.

The solid part of the earth is made up of rock material which is covered by layers of soil of various depths. Outcroppings of rock may usually be seen along highway cuts and hillsides and, of course, in mountainous areas. As a result of the action of running water, wind, ice, and the atmosphere, these rock outcroppings are changed in different ways. Sometimes huge portions of rock material separate from the parent rock. In turn, these pieces are broken into smaller pieces. Plants and animals also play a part in breaking up rocks. Thus large rocks become small rocks, and eventually the finely disintergrated material forms the basic part of soil.

Some boys and girls live where there are many rocks. They see boulders on hillsides and in valleys, notice them along streams and washes, observe massive outcroppings in mountainous areas and in highway cuts, and find rocks on beaches and in caves. There may be rocks in their yards at home, in nearby parks, and along their streets. However, some children may live where deep soil covers most of the rocks. Their contact with them may be through rocks brought in for construction and ornamental purposes. Or they may see them along highway cuts or streams.

Rocks are an important aspect of a child's environment, and he usually is interested in finding out about them. *Science Near You* points out differences in rocks that young children can easily observe. The situations suggest activities which can be carried on while finding out about rocks seen around school or at home. Attention is focused on ways a teacher may utilize resources near the school building and offer children time to investigate and discover for themselves. After the exploratory period, she may sit down with them to talk through

their findings, hear their questions, and help them as they summarize some of their ideas about rocks they have seen. Boys and girls need many opportunities to find out for themselves and to have guidance in making interpretations about the rocks around them.

Science Meanings for Children

Several science meanings pertaining to kinds of rocks are developed in the chapter. They are as follows:

Many rocks are big and many are little.
Some rocks are soft and some are hard.
Some rocks feel smooth and some feel rough.
There are many kinds of rocks.

While finding out about rocks children have opportunities to gain experiential learnings which bear upon the basic patterns of change and variety.[1] Rocks differ in appearance, size, hardness, color, density or specific gravity, and in other ways. As children see and feel different rocks they begin to draw conclusions about these variations.

Information for the Teacher

At an early age children show an interest in rocks. They pick them up for various reasons. We do not always know what motivates a child. It may be that he considers the rocks pretty because they sparkle or contain crystals. The feeling of smoothness or roughness also may appeal to a child. Children of various age levels bring rocks to school and ask searching questions about them. Why are they of different colors? What makes them sparkle? Why are some soft and others not? Why do some have streaks (layers)? How were they made? Why do we find them in some places and not in others? What makes some rocks smooth? Such questions show that young children need numerous opportunities to find out about this phase of their environment.

For her own background a teacher may want additional information about rocks. There are many different kinds of rocks but for purposes here it is sufficient to say that they vary in the way they were formed, in hardness and softness, roughness and smoothness, color, specific gravity or density, size, grain, structure, and whether or not they are crystalline in nature. These differences will be expanded further.

[1]For a further discussion of these patterns, see the Foreword, pp. xviii–xix, xxi–xxiii.

The hardness or softness of rocks is the result of the way the rocks were formed, the action of air and water on them, and their chemical content. Some rocks crumble so readily that they can be broken with the hand. Others disintegrate when rubbed against a hard rock or other resistant material. Children may use crumbling rock in such materials as clay and chalk. In contrast, many rocks are very hard. A few are hard enough to scratch glass.

Some rocks are rough. When a rock is first broken, it is very rough. It gradually becomes smoother as it hits other rocks and especially as it is subjected to water. The large rocks and pebbles in streams, washes, and along the shores of lakes and oceans are frequently very smooth. In time the scouring action of water produces polished surfaces as it forces sand and stones around the rocks. Those which have not been subjected to this scouring work of water are usually rough and sometimes jagged. Another reason for many rocks being rough is that they are composed of very hard material that does not disintegrate readily.

Rocks vary in color. This is due to the difference in their chemical content. For instance some rocks contain much iron, which affects their color. Children may be surprised when picking up certain rocks to find that they are lighter than their size suggests. An example of a light rock is pumice, some of which is so light it will float on water. Of course, the size of rocks varies. Some are very large, others are small, and many are tiny stones or pebbles. Various rocks are coarse-grained, and others are fine-grained.

Boys and girls find rocks that are in layers. Some of these show the effect of folding or bending. Children are concerned about such structures and want to know about the layers. Crystals in rocks are also noticed by boys and girls. If they use a magnifying glass to examine these more closely, they may observe variation in the size, shape, and color of the crystals.

Some rocks were laid down in the form of sediment by water, wind, or ice. At a later time, possibly thousands of years, the tremendous pressure of water and additional sediment compressed these fine particles and they were cemented together to form rock layers. Such layers can be seen in rocks children bring to school. Other rocks were formed in a very different way. Hot rock material from deep down in the earth flowed upward through cracks, out of an old volcano, or perhaps in a way which resulted in a new volcano. Sometimes this hot material did not reach the surface of the earth. Therefore, it cooled slowly and produced rocks with larger crystals than those which cooled rapidly at the surface of the earth. Many rocks are altered by great pressure and heat. These processes of rock formation are continuously going on today just as they have been for thousands and millions of years.

Ways of Working with Children

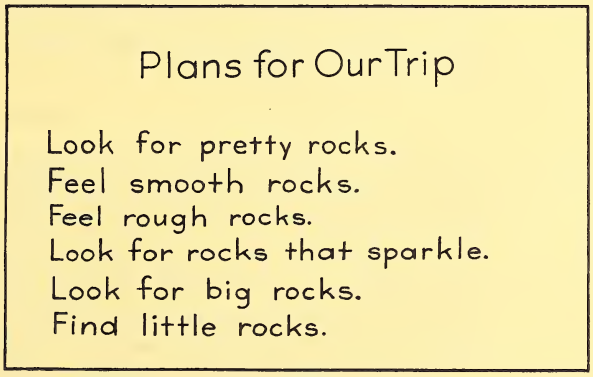
"Rocks Near You" might be introduced for the purpose of encouraging children to observe and ask questions about a rock formation on the school grounds or nearby in the neighborhood. Possibly rocks are being used in construction work which the children observe. Perhaps they have seen a power shovel excavating for a new building in a place where there are many rocks. Or the children may have talked about rocks they saw along a small stream or in a gravel pit in the neighborhood. If there has been no evidence of curiosity about rocks, this chapter might be used to interest children in looking for them, examining them, and taking walks to see them, and thus lead to concept development about an important natural resource.

Pages 56–59 · Rocks Near You

Many rocks are big and many are little.

Page 56 · Provide time for children to tell of their observations and talk with you about their rock collections. What do they want to know? What have they found out? What do they think they might do to further their experiences?

The illustration on page 56 might prompt children to tell where they have seen rocks. They may suggest going some place where their group can examine rocks just as the children in the picture are doing. Plan with them to take a walk, or perhaps it will be advisable to go by school



bus. If their plans are listed on the board and later placed on a chart, the children may be helped to plan carefully, make specific observations, and carry on a discussion when they return. Plans such as those in the chart above might be suggested by the children.

Other plans will need to be made, such as what the destination is to be, stops that can be made en route to see rocks, how much time will be needed, and possibly what to take for a snack. If you decide to use a bus, more planning will be involved, such as selecting a committee to talk with the principal about advisability of taking the trip, gaining permission to use a school bus, taking a note home to tell parents of the anticipated trip besides asking their permission to go, and possibly inviting some of the parents to accompany the group.

During a trip it is advisable for the group to come together, as shown on page 59 of the textbook, to discuss their observations and raise questions. Encourage them to speculate as to why some rocks are big and some very little. Lead them to recall other places where they have seen small and large rocks. In what way do the small rocks look like the large rocks?

After returning from their trip, motivate the children to read their chart and check the plans they were able to carry out. Help them evaluate their experiences through questions, such as: What made it a good trip? What did we find out?

Some rocks are soft and some are hard.

Page 57 · When discussing information given in *Science Near You*, do the children refer to their own experiences with soft and hard rocks? Some children might demonstrate how they, too, have found rocks which they can break with their hands. Perhaps someone will show that some soft rocks are softer than others by rubbing two rocks together. If they are held over a piece of paper the rubbed-off particles can be seen readily. A magnifying glass might be used to observe the small particles of the softer rock.

Some rocks are smooth and some are rough.

Page 58 · If the children found smooth rocks on their trip, they may have speculated or set up some hypotheses as to why they are smooth. They can check their ideas with information given in the text. After they have read it silently, give them an opportunity to discuss what they found out. Lead them to recall places where they have found smooth rocks, such as at the beach, along a stream, or in a wash. Focus on the action of water, sand, and other rocks in this scouring process.

Page 59 · What Kinds of Rocks Are Here? Children need to have some place to put rocks where they can easily look at them, feel them, and make comparisons. Encourage the boys and girls to plan some kind of organization which will point up likenesses and differences and other findings they make. They may use cardboard boxes and plan labels for these, such as "Smooth Rocks," "Rough Rocks," "Hard Rocks," "Soft

Rocks," "Pretty Rocks," "Rocks That Sparkle," and others. A magnifying glass will be useful in examining the rocks.

Sometimes children block together several orange crates to have a shelf for each of their groupings. Wide wrapping paper fastened securely around three or four crates put together helps to make the groupings into a well-organized unit and also furnishes a place for the children to arrange pictures showing rock formations.

Through such experiences they may gather additional evidence, make interpretations, and apply their findings. The illustration on page 59 of the textbook might lead the boys and girls to recall their walk and how the group met to talk over what they had seen and to ask questions. This situation may demonstrate the importance of occasionally sharing ideas and thinking through problems.

Another purpose of the page is to encourage children to recall their experiences with rocks, talk over what they have found out, and draw conclusions. They might summarize their learnings by listing some of them for a chart which could be used for further reference.

Materials Needed

For use with *Science Near You*:

- cardboard boxes
- magnifying glass
- orange crates
- pictures of rock formations
- rocks
- wrapping paper

For use with Further Experiences:

- magnifying glass
- pieces of sandstone
- rocks

Further Experiences

Making Sand · Children might examine pieces of soft sandstone under a magnifying glass and then grind them together. This shows how sand can be made.

Changing Color of Rocks · Place rocks in water to see if the colors become brighter.

Evaluation

If your children show an increasing interest in rocks, ask many questions, and make numerous observations, you will have evidence that their experiences have had purpose and are considered worth while by them. In what ways are they growing in their concepts about variation in rocks and ways some changes take place? How have they gained in

ability to differentiate between likenesses and differences in rocks? In what ways are they becoming more resourceful in looking for places where they can find rocks? How are they gaining skill in making observations? Do they speculate and set up hypotheses concerning their ideas about rocks? Which children show a willingness to test their hypotheses? Have you noticed a choice of language indicating open-mindedness? You may observe many other kinds of behavior on the part of individual children. From such an evaluation clues may be gained that will help in planning for further experiences for the group. From time to time throughout the year, children may derive additional experiential learnings about rocks and gain in ability to make interpretations. Their concepts about the earth will be deepened as they use other books in the series SCIENCE TODAY AND TOMORROW.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 227–310. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition, pp. 97–99. Wm. C. Brown Company, 1955.

For the Children

Cormack, Maribelle. *The First Book of Stones.* Franklin Watts, Inc., 1950. Excerpts may be used with the children but the entire book will be useful to the teacher.

X

Land Near You

There is considerable variation in land forms on the earth's surface. In some places the land is relatively flat where one can see for miles and miles around and where the soil over the bedrock is very deep. In others there are rocky areas and low rolling hills which extend into wide-spreading plains. In still other places there are high mountains with precipitous rocky canyons and foothills leading to gradual slopes below. Rivers run down these canyons and through lowland areas cutting their way to the oceans. There are many other differences to be considered when developing the idea that the land is not the same in all places.

Through his paintings, play in the sand, and conversation, a child may reveal his awareness of the hills or mountains around him. Perhaps after driving to their mountain cabin many times, he paints a picture of the family car on a steep highway that zigzags its way up the mountain. Thus he shows that he has had sensory experiences relating to changing elevation on the way up and down. Another child expresses differences in topography as he makes hills, mountains, valleys, and roads in the sand. Boys and girls who live in places where there are great contrasts in elevation undoubtedly are much more aware of variations in topography than children who live where the land is comparatively level.

Situations presented in *Science Near You* offer opportunities for children to become alerted to differences in land formations around them, discuss the appearance of their landscape from different vantage points, and think how it feels to go up and down hills. Attention is focused at the beginning on places where there are hills and rocks such as were shown in the preceding chapter, thus making use of a familiar concept to develop ideas further.

Air views give a feeling for the land around, the highs and lows, the way the river cuts through the land, and the way places look when

they are far away. Emphasis is given also to the actual muscular experience a person has when going up or down hills. Besides developing these concepts, the book suggests activities that focus on differences in land formation.

Science Meanings for Children

As children observe the land around them they need guidance in seeing the bearing of one fact upon another so that they can begin to think in terms of geographic relationships. They also need experiences which will help them gain a motor sense of elevation, such as walking uphill and downhill and going to a high location to look down over the land below. From such experiences concepts may develop along the large patterns of space, change, and variety.[1] The following science meanings may give direction:

Land is not the same in all places.
There are hills in some places.
There are rocks in many places.
It is easy to go downhill.
It is hard to go uphill.

When children look over the land around them from a high vantage point, they may develop a feeling for space and begin to see relationships. They may see that some places are far away, and that their homes are close by. They may find out that the lake and park, for example, are farther away than the school building. Later they may walk from their school to the lake or park and gain a better concept of the distance or space between these places. After walking down from their vantage point, they might look up to see where they have been and compare the things that can be seen from each place, and thereby develop a feeling for space.

When observing the land in several different locations, children may extend their ideas relating to the pattern of variation. By seeing hills in some places, valleys in others, rocky places nearby, a river or wash, and perhaps a rolling countryside, children may gradually begin to summarize their ideas about the way land varies from place to place.

Possibly boys and girls develop a feeling for energy as they go up and down inclines, such as steps or hilly streets. They will find that it is much easier for them to go down than up. The motor sense gained by

[1]For further discussion of these patterns, see the Foreword, pp. xv–xvi, xviii–xix, xxi–xxiii.

using the human body may be extended as they consider various modes of transportation and discuss what happens when a train, car, or truck goes up or down a steep hill. As children participate in such experiences and develop a feeling for energy they will extend their ideas along the large pattern of change.

Information for the Teacher

The very young child experiences a difference in elevation as he haltingly walks up an incline and then gleefully runs down. He quickly finds that it is much easier to go down than up. Through such activity he gains a motor sense of upward and downward movement. The three-year-old has difficulty propelling his tricycle up the slightly elevated street but can relax as he heads downward to his house. Pulling his wagon up a long hill is hard work for the six-year-old. The sensation he has when he pulls a wagon uphill is quite different than when he holds it back going downhill. An even greater contrast is felt when he uses his sled.

Some variation in topography may be noticed by young children, especially if they live where there are hills or mountains. A child gains one type of impression as he looks at hills, but he develops a very different concept when he has the actual muscular experience of climbing. When arriving at the top of a hill, he looks out over the city or countryside to see the land spread out below in all directions. He sees some of it close by and some far away in the distance. There may be level land, a narrow valley, hills, or possibly mountains in the distance. A meandering river may be winding its way through the valley. There may be huge rocks in some places.

As the child views the land he tries to orient himself in space. Some hills may appear near to him even though they are far away. The mountain may not seem as high as he had anticipated. When going down the hill, he looks up and gains other impressions. The hill looks very different from the way it appeared at the top or as he sees it from his house. He finds it difficult to adjust himself in space, but as his experiences are extended he increases his perception.

Instead of going to a hilltop he may look out over his city from a high building. He may see his apartment house and the park close by. The hills in the distance do not appear the same as they do from his apartment and neither does the river. From this vantage point he can see that the land is not the same everywhere. Other places from which to look out over the land might be any sizable open area or a window with a view.

The children with whom you work may live in a place where the land

is comparatively level. Maybe they can see the land around them for a long distance. Perhaps they live where there are low rolling hills which extend into wide-spreading plains. Possibly they live near high mountains where there are rocky canyons and foothills leading to the gradual slopes below. Maybe there is a river which is cutting away the land near some child's home. Or there may be a lake in your neighborhood.

Many children live in dry regions; others in regions that are moist. Some live near seacoasts. Many others live inland far away from coastal areas. They may live in any one of many different regions. There are deserts, semideserts, and sand dunes. There are high, snow-capped mountains, rocky elevations, and forested hills. There are regions of grasslands, farm lands, and forest lands. There are bayous, everglades, and lakes. Gradually children may develop the concept that land is not the same in all places.

Ways of Working with Children

You might start the chapter with children in various ways. One motivation might be a trip they have taken with you which awakened their interest in differences in topography. Or you might start with a common everyday experience. In this connection *Science Near*

When playing in sand, young children frequently make representations of land forms familiar to them.

You might be used to make them aware of possibilities relative to such an experience. For instance, children frequently make hills and valleys in a sand pile. With your guidance many learnings can evolve from this experience. Also, the chapter can be introduced to develop an awareness of land use in the community, provoke discussion, encourage observations, and deepen concept formation.

Pages 60–69 · Land Near You

The land is not the same in all places.
There are hills in some places.

Page 60 · The pictorial air view of a small rural area may help boys and girls see the geographical relationship between places where John and David live and where Ann expects to live. Discuss the place where John lives on the hill and that he passes the place where Ann will live as he goes down the hill to visit David. Lead the group to focus on how the boys go up and down the hill when they visit each other. As a result, your children might begin to think of going upward and downward as they use the chapter. Prompt them to talk about the river in relation to the lake. Where do they see hills? Where do they see fields? What seems very far away? What seems close by?

Motivate them to tell how the land looks around their homes. Do they need to go uphill and downhill? Encourage them to compare the land around their homes with the region where John and David live. Plan with them to take a short walk if there is a place nearby where they can see for some distance in order to gain an overview of the land in the immediate neighborhood. You may be located in a place where you will get your best view from a high building.

Rocks are found in many places.

Page 61 · Help the boys and girls bring out the idea that rocks can be found at the top of the hill as well as part way down where the power shovel is excavating. Encourage them to recall places where they have observed rocks and compare these with the places where John sees rocks. Have they seen a power shovel moving rocks? A power shovel might be excavating nearby for a new house or an addition to the school building. If so, take the children to see how it works and find out if it digs up rocks. Prompt the group to anticipate why John is taking his toy power shovel with him.

The land is not the same in all places.

Page 62 · If the group has taken a walk to a high place, they will bring much meaning to their discussion of the page. What is the relation

of the river to the lake, to the hills, and to David's home? What things look very far away in the picture? What looks close by? Which places are high and which are low? With the emphasis given by such questions, members of your group might begin to develop concepts along the large patterns of space and variation.

If possible, plan with the children to take a trip in the school bus to a hill where they might look down and see their homes or other places of special interest in the community. What suggestions do the boys and girls have for a good lookout place to which they might go on this trip? Those who have been to this place before might help orient the group to what can be seen. Guide them in deciding to look for high and low places, near and distant land, washes or streams, rocky places, and streets or highways.

Such planning should help children make careful observations. Besides these plans it will be necessary for them to think through the rest of the organization for their trip. They will need to talk with the principal about their plans, secure permission to use the bus, and take notes home to their parents. Each note should give information about the trip and ask permission for the child to go.

Listen for spontaneous reactions during the trip. What impressions are the children getting? Are they recalling other experiences as they make observations from the hilltop? Are they gaining a feeling for spatial relationships? Do you see results of their careful planning? After you return from the trip, provide an opportunity for them to express their impressions by making large chalk pictures. Encourage them to tell about their pictures by helping them focus on ways in which they have shown differences in the land. You may gain clues that will help you in later planning.

It is easy to go downhill.

Page 63 · Undoubtedly all the boys and girls have pulled something downhill; however, they may not have paid any attention to the accompanying sensations. Encourage them to discuss how John might feel as he walks downhill holding back his wagon. To give emphasis to the muscular reactions, each child should have an opportunity to pretend he is John as he walks down an incline holding back a wagon. Then suggest that he turn around and go uphill. If there is no hill near you, they might use a ramp in the building or possibly substitute a wide board for a ramp.

What spontaneous responses do you hear about going up and down a hill or ramp? What interpretations do the children make of this experience?

Lead them to anticipate where John and his dog are going. Suggest

that they read the text to find out why he is walking downhill. Encourage them to discuss what they learn from the text.

When studying the illustration at the bottom of page 63, there is an opportunity to develop the geographical relationship of land to water. Encourage the children to look back to pages 60 and 62 where the river is first pictured in order to orient themselves and make comparisons. Prompt them to read the text, discuss the information it gives, and find the river in the illustration.

The land is not the same in all places.

Pages 64–66 · Provide time for the children to tell of their experiences in making hills in a sandbox or at the beach. As they discuss the activities of John and David in the sequence of illustrations plan with them for ways in which they, too, can portray land forms where they live. If you have more than one large sandbox, a number of children can participate at the same time. They may make high hills and low hills; mountains, foothills, and canyons; rivers, lakes, and oceans; and streets and roads. Such experiences provide opportunities to develop muscle images of land forms. Later visual images of these forms may be better understood when seen in pictures.

After the children have worked together in the sand in small groups or in some cases individually, they should have an opportunity to share the results of their work with others. Through discussion many ideas might evolve which could lead the group to plan further activities and thus to extend the possibilities for concept development. When observing the boys and girls at work in the sand and when helping them to read and discuss the text, you may notice growth in their purposes, vocabulary, and understanding. There may be need for additional observations to clarify concepts.

The land is not the same in all places.

Page 67 · John and David's Map · Sometimes children wish to go beyond the manipulative stage they have experienced with sand. They want to produce permanent results which they can keep and use from day to day. To do this a large floor map can be made on heavy, wide wrapping paper. Several strips of paper can be taped together and then taped to the floor around the edges.

Using their experiences at the beach in representing the topography around their homes, John and David are shown working on this type of large floor map with other children. In planning such a neighborhood map, you might help your group scratch their plans on the playground or chalk them very roughly on the floor or on a hard-surfaced area outdoors. This enables them to plot their ideas and then change them

easily if necessary. During this orientation the children might clarify their ideas by using blocks or other objects to represent buildings, hills, and a river. After members of the group have made some definite decisions about general placement of their hills, streets, roads, bridges, and other important features, they may be ready to chalk in these plans on the large floor map. Later, when they decide their markings on the map are satisfactory, they can paint them.

The red truck carried the pipes and put them in the ditch.
We are watching some men put cement over the pipes.
The blue truck brought the welding machine. It made a lot of noise.
Two men are covering the pipes with dirt.

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Gradually boys and girls develop concepts involving geographical relationships as they make and use a large floor map of their immediate neighborhood.

As a result of representing land forms in the sand, children will have a background to help them create hills for their floor map. This can be done in various ways. You may wish to use the following procedure. Fasten a mound of crumpled newspaper on a piece of thick cardboard. Dip a paper towel into a very thin mixture of paper-hanger's paste and spread it over the hill of newspaper. The towel should be pressed down firmly on the newspaper until it sticks well. After the hills dry, the children can paint them with calcimine paint and place them on the map.

Small blocks of wood in various shapes might be placed on the map to represent the school building, houses, stores, barns, or other structures. Cars, trucks, and other items might be added as the children use the map in their imaginative play. Also, they might wish to make a mural

for a background, such as the one back of the children's map on page 67 of *Science Near You.* They can stand trees in small mounds made by mixing sawdust and paper-hanger's paste. The mixture provides a good support when dry.

This type of third-dimensional map aids children in developing their understanding of geographical relationships. For instance, they may begin to compare hills with mountains in the distance, find out why rivers run where they do, or why streets are sometimes winding. As the children use the map they may become aware of the need for more facts. The map may serve as a source of reference to help children communicate ideas to others when sharing information with them. Map-making offers many opportunities for small groups to work as committees, as well as for planning and evaluating by the total group. Which children are developing more resourcefulness and responsibleness as they make suggestions and work together? In what way are they growing in ability to consider the ideas of others? How is credit given to others for their contributions?

It is easy to go downhill.
It is hard to go uphill.

Page 68. The Land Up and Down · When listening to their spontaneous reactions as they use the map, do you hear children say how hard it is to go uphill and how easy it is to go downhill? The book might help them summarize their ideas concerning variations in amount of energy required to go uphill and downhill. Encourage boys and girls to discuss how it might feel if they were doing what the children in the pictures are doing. In what way do they refer to their own muscular experiences as they summarize? Which children are improving in their ability to draw conclusions?

Page 69. How Does the Land Look Near You? Not only is it advisable to summarize relative to the energy expended in going up and down, but it is also important for children to draw conclusions about variations in land forms after they have had numerous experiences. When answering the question on the page, it will be necessary for boys and girls to think how the land looks at school and what it is like around their homes. The four illustrations point up two science meanings, namely, land is not the same in all places, and there are rocks in some places.

In summarizing the chapter it might be helpful for the children to organize magazine pictures of land forms on charts or the bulletin board and suggest captions, such as "Hilly Places," "The Desert," "Mountains," or "Rivers." Committees might look for pictures and pin them under the appropriate captions.

Materials Needed

For use with *Science Near You*:

- blocks of wood
- calcimine paints
- cardboard
- chalk
- newspapers
- newsprint, 18″ × 24″
- paper-hanger's paste
- paper tape, 2″ wide
- paper towels
- pictures of land forms
- sandboxes
- sawdust
- sticks
- toy cars
- toy trucks
- wrapping paper

Further Experiences

Painting Pictures · Encourage children to paint pictures giving their impressions about the land around their homes, observations made on a walk, or ideas gained when driving with the family. Listen for spontaneous comments about these paintings.

Making Booklets · Paintings made by children might be compiled in booklets. Possibly they can dictate their ideas about the pictures for you to record in the booklets.

Evaluation

When using the chapter there may be many times that children make overstatements and draw conclusions with insufficient evidence. For instance, some land forms may appear one way to them at a certain time, but after having more experiences they may change their ideas about them. In what ways are the children spontaneously expressing themselves relative to ideas involving space and variation in land around them? Which children tell about observing differences in the land while riding in the family car? What evidences are there of critical thinking as the children develop a map of their immediate neighborhood? In what way is the map experience helping them to improve their spatial concepts as they attempt to place things in relation to a point of reference?

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 265–310. Ginn and Company, 1958.

For the Children

Berkley, Ethel S. *Ups and Downs: A First Book About Space.* William R. Scott, Inc., 1951. Concepts of up and down, top and bottom, high and low, and over and under are developed through stimulating text and illustrations.

Zion, Gene. *All Falling Down.* Harper & Brothers, 1951. Full-page colored illustrations and a small amount of text develop ideas about gravity.

XI

Plants in Many Places

Plants grow in many different places, with each kind of plant located in its own particular environment in accordance with the scheme of distribution. For example, some grow along streams where there is a suitable amount of moisture; others flourish in hot, arid, or semiarid regions. Temperature and moisture are not the only factors influencing the growth of plants. Variation in altitude is another determiner of where they grow. Conditions in coastal areas affect the kinds of plants found there. Plant life of oceans and lakes is influenced by various conditions. Then, too, fresh-water plants of lake, pond, and stream differ from those growing in the salty ocean. Plants thrive or fail to survive as a result of the different conditions in their environments. They are found in many places, but they are not distributed over the surface of the earth by chance or in a hit-and-miss fashion.

Various kinds of plants grow together in a particular environment. Some may be tall and others very short. Some may have large trunks; others may be slender. Many plants have large leaves like those of a sycamore; others, such as a fir, have small ones. The shape of trees varies, too. The branches of a maple spread out making a large round top; those of a spruce grow in a conical shape. Some plants grow rapidly and are short lived; others grow more slowly for many, many years.

A large number of trees drop all their leaves at one time; others lose them gradually and thereby remain green throughout the year. Among other differences of trees are the kinds of flowers and seeds. Some trees are a mass of yellow, blue, or white when in bloom. Others have flowers which are inconspicuous. Some seeds form in pods. Some have wings and the wind may carry these far from the parent plant. Some form in cones that drop to the ground close by.

There are innumerable opportunities for children to have experiences which help them make comparisons between plant environments. By using *Science Near You*, boys and girls may be stimulated to think

of different places where they have seen plants. They may see variations in kinds of plants just by looking out their windows. They may take walks to see how many different kinds of plants they can find living in one place.

The chapter opens with an illustration showing the children at a good vantage point on a hilltop where the view includes a variety of plants growing in many different places. Later, attention is focused on plants in woods, around a home, in and around a pond, in a wilderness area, on the desert, in a garden, along a highway, and in a park. When using *Science Near You*, children may recall their impressions, express their ideas, and make additional observations of places plants grow in the neighborhood.

Science Meanings for Children

Even though boys and girls have been around plants in various environments, they may not be especially interested in why some plants grow in the woods or on the desert, or why all plants do not grow everywhere. However, children may begin to be curious about plant growth as they plan with you for ways to gain information and follow through by taking walks, making observations while riding on the school bus, talking with other people, planting a garden, or finding out from other sources. As a result, they may become more resourceful and intelligent in their behavior concerning the growth of plants in their neighborhood.

During discussions, walks, and other activities, boys and girls may begin to derive science meanings which contribute to their understanding of the large basic patterns, ideas, or principles of adaptation, variety, and interrelationships.[1] The following meanings developed in the book might help you in guiding interpretations along these larger ideas:

Plants grow in many places.
Some plants are big.
Some plants are little.
There are many kinds of plants.

Gradually, boys and girls may begin to see why some plants grow only in certain places. Concepts may develop which involve the beginnings

[1]For a further discussion of these patterns, see the Foreword, pp. xx–xxiv.

of ideas about the relationship between plants and their need for water, sunlight, air, and food. The relationship between the variation in plant life and the places where it is found may be pointed out as children become more aware of this phase of their environment.

As a result of the concepts developed while using the book, children may gain a background for helping them consider more specifically in the next chapter some of the factors which determine the growth and distribution of plants.

Information for the Teacher

Young children have contact with plants no matter where they live. Attention of the three-year-old, as well as that of the five- or six-year-old, is sometimes focused on plants around him. Children may see plants growing in yards and parks, along streets, in vacant lots and fields, on deserts and mountainsides, along streams, in lakes and ponds, and also indoors. Some of these environments may be dry, others moist. Some may be especially warm, others much colder. Some plants may grow high on a mountain, others in a valley. Boys and girls might observe that the plants growing in their yards are different from those in the vacant lot down the street, or that those seen in the pool at the park are not like plants in the flower beds there. Frequently weed patches and thickets at the edge of the school grounds are useful for this kind of observation.

Children may see trees around their homes, the school, or park, and observe that these vary greatly in size, shape, leaves, flowers, pods, and time they lose their leaves. Besides noticing the large trees, boys and girls may observe that many plants are very small. In addition, they may find that small plants also vary in the kind and color of flowers, and that some plants are good to eat. They may find that a few around their homes grow in shady places, but that vegetables grow best in a sunny place.

If there is a stream near your school, boys and girls may see poplars, willows, and alders growing along its banks where there is adequate moisture. Mosses and many other plants may be found reaching down to the water's edge. These water-seeking plants also vary in relation to climate and soil conditions.

On the other hand, your children may be living in a semiarid region, where there is a noticeable contrast in vegetation. Numerous plants which are drought and heat resistant grow in this kind of place. Juniper, pepper, and locust trees, as well as Joshua trees and palms, may be seen. Mesquite and creosote bushes also grow in this environment, along

with many varieties of small plants. After a spring rain the desert may be covered with delicate flowers close to the ground. Some of the minute, inconspicuous plants produce beautiful flowers, well out of proportion to their size. A small amount of moisture creates great changes in a semidesert area.

Your children may live in the lower foothills at the base of high mountains. This environment offers a suitable place for certain plants because of the cool temperature, the ample rainfall, and the type of soil. At higher altitudes the vegetation gradually changes. The trees, bushes, and smaller plants growing there are adapted to the coarse soil, temperature, and amount of precipitation usually found there.

You may be working with boys and girls who live in coastal areas. Rocky, precipitous coast lines support one type of growth, and sandy dunes along the beaches produce another kind of plant life. Rocky or sandy soils, a foggy, damp atmosphere, mild temperature, and the amount of wind will have affected the kind of vegetation the children find there.

Varying situations around the schoolyard may make it possible to observe several types of plant environments. A shaded area offers conditions suitable for the growth of plants which are quite different from those growing in an open sunny place. Frequently desert or semidesert conditions may be illustrated by a patch of ground along the sidewalk or around the sandbox where only plants requiring sandy soil and a minimum amount of moisture will grow.

Observations at a vacant lot provide information about some kinds of plants which are native to the area. At different times during the growing season the development of the plants found there will vary. Some will grow very fast, crowd out the smaller ones, and produce so much shade that those requiring a greater amount of sunlight cannot survive. The vegetation of such an area offers striking contrast to that of the well-kept private yard or public park.

Not only is there variation in plant environments but plants in the same environment may be very unlike in appearance. For example, the giant sequoia, a native tree on the western slope of the Sierra Nevada Mountains, may grow to a height of three hundred feet or more, with a trunk as much as thirty-five feet in diameter. It is the most massive of all trees and, according to estimates, some of the oldest have been growing about three thousand years. In contrast, growing in the same forest with the giant sequoias are much smaller trees, bushes, grasses, mosses, and even lichens. Different kinds of plants growing in the same environment may vary in height, size, shape, manner of growth, type of flower, and time they lose their leaves.

Some trees grow very straight, such as the lodgepole pine; others, like the oak, form many angular branches. The hard maple develops a crownlike top, as do many other trees. The grape sends out curlers which twine around other plants, fences, or anything else nearby that offers support for the vine. Many plants send long roots far into the ground; others have very short roots. The carrot, beet, potato, radish, and turnip, among others, develop large parts in the ground.

Another striking difference which boys and girls may notice among plants is the variation in flowers. For example, the horse-chestnut and catalpa trees bear white flowers in large clusters; one of the magnolias develops showy and fragrant single white flowers, seven to ten inches across. In contrast to the inconspicuous flowers of some trees, fruit trees become a mass of beautiful flowers in the springtime. Some of the small delicate flowers of the desert often go unnoticed, overshadowed by the brilliant colors of the cactus flowers nearby.

There are other innumerable ways in which plants differ. Boys and girls may observe many of these variations as they become more aware of the plants in the environment around them.

Ways of Working with Children

Boys and girls have great potentialities for contributing information concerning the plants around their homes or in the neighborhood. They may be carrying on an activity which has stimulated concern about plants, such as planting a garden, finding out about the plants observed in a market, discussing plants which the farmer told them about when visiting his farm, seeking information from the nurseryman in relation to planting they wish to do, or caring for plants in their classroom. If so, this chapter might help to further their thinking. On the other hand, the book might introduce the idea of finding out about plants and direct children's attention to the variation in vegetation around them and to the relationship between the growth of plants and the environment.

Pages 70–75 · Plants in Many Places

Plants grow in many places.
Some plants are little.
Some plants are big.

Pages 70–71 · The purpose of these pages is to help children develop an awareness of plants growing in many places. As boys and girls talk about places they have seen plants growing references may be made to variations among plants and the kinds of environments in which they grow. Encourage discussion of the similarities and differences in plants

regarding size, shape, and color. By asking questions about the picture, the following information may be brought out: plants grow far away; plants grow close by; some are in town but many grow in the country; plants grow on hillsides; they are found in the valley; some of them grow around the lake; and farmers grow many plants in fields and around houses and barns.

If the words on page 71 have been used many times in the discussion, some children may be able to read to find out what Mary, Ann, and Ann's father are saying while looking at the countryside. The text will carry considerable meaning if children are led to offer their own ideas about the picture and discuss places in which they have seen plants growing.

As these six-year-olds talked with the nurseryman they found out about plants for their school garden and saw many plants growing in the nursery.

Los Angeles County Schools

Encourage your children to question and speculate why plants grow where they do. In doing so, are they recalling past experiences and making application to new situations? Are they suggesting ways of finding answers to their questions? Do they take a walk to see where plants grow near their school? Perhaps they will go a few blocks down the street or a short distance up a hill to get an over-all view of the area to help them answer some of their questions. If a small park or vacant lot is nearby, the group might also go there to observe plants growing.

There are many kinds of plants.
Plants grow in many places.

Page 72 · Some plants require a shady place. The illustration at the top of the page may lead children to question and think about wooded places they have seen. Encourage them to tell of their impressions while walking through a woods. Perhaps they will refer to the shade, streaks of sunlight, effect of coolness, moist soil, and the covering of leaves, twigs, grasses, and other small plants. From such experiences some of the children may begin to see relationships between the kinds of plants shown in the illustration and the type of environment.

When discussing the plants of a wooded area, there will be additional opportunities to guide children in the development of ideas involving the large pattern of variation. Use the illustration in calling attention to the similarities and differences among plants growing in one place. Give the children an opportunity to talk about the large and small trees, bushes, ferns, flowering plants, and grasses. Also, they might imagine how it would feel to be in the woods, thus providing an opportunity to focus on the moisture, dappled light, and coolness of that environment.

The question "Where do you see plants grow?" may prompt children to recall their own experiences and lead to further observations. You might make plans with them to look for plants on the way to and from school and at home. Their impressions might be shared by painting large pictures. Such an experience calls for making interpretations and organizing ideas. It stimulates observing carefully, and provides opportunities for creative expression in communicating ideas to other people.

At the bottom of the page, Ann is shown talking about the small grass plants in her yard. Encourage the children to wonder why Ann is concerned about the grass in her yard and anticipate what she is saying. It might be profitable for a child to single out one grass plant in order to focus on its size. Perhaps the illustration will prompt the group to look for the smallest plants growing near them.

After studying the sequence of illustrations on pages 70–72 of *Science Near You*, a walk might be taken to see several places where plants grow. It is most important to plan very thoroughly with children before going. For example, you will want to decide what to look for during the walk. Their ideas might be listed on the board and later placed on a chart similar to the one on page 134 of this Manual. Before starting out, the children might reread their plans in order to have their ideas clearly in mind. The chart might be used again after the walk to guide discussion of their observations. Such a walk provides excellent opportunities to develop resourceful and responsible behavior. You may observe how the children

Our Walk

Look for big trees.
Look for bushes.
Watch for little plants.
Watch for flowers.
Look for places plants grow.
Look for plants on the hill.
Look for plants on the street.

show improvement in readiness to leave the environment as they find it rather than collect specimens or break off parts of plants as they may have done previously on walks.

A discussion after this type of study trip opens up numerous opportunities to assist children clear up misconceptions, clarify concepts, and make interpretations. Some of the boys and girls may not be ready to participate in a discussion soon after the walk. However, several days later you may hear and see evidence of learnings they have gained. Children need time to ponder, to internalize, and to apply their ideas.

Plants grow in many places.
There are many kinds of plants.

Page 73 · Encourage children to draw upon their experiences as they study the illustration showing Ann and her mother in the flower garden. It may prompt them to tell about flowering plants at home or in the park. Sometimes children work with members of the family in planting a flower garden and help pick the flowers. As the children discuss the picture and talk of their own experiences they may show growth in developing ideas involved in the pattern of interrelationships.

As they read "Look for plants around your home" they may be prompted to make special observations. If their plants have flowers, some children may bring a few to school, which will help to illustrate the variation in flowering garden plants. Many similarities and differences can be observed in parts other than the blossoms. It may be advisable to plan with the group for a visit to some child's flower garden or an interview with a gardener in the neighborhood about his flowering plants in order to observe many kinds and varieties.

Children in your group may have been to a lake or pond where they saw plants growing in the water. Lead them to share their information with the others. As they study the picture at the bottom of the page

they can see many plants growing in the marsh around the pond and in the water, illustrating another variation in kinds of plants and environments.

In order to help boys and girls apply some of their learnings about places plants grow, it might be helpful for them to look for pictures in discarded magazines and seed catalogues or other available sources. Committees might organize these pictures on the bulletin board, on charts, or in scrapbooks under several headings, such as "Plants Grow in Our Yards," "Plants Grow in Water," and "Plants Grow in Many Places." This type of activity provides an opportunity to evaluate experiences, organize materials, and summarize learnings.

If a wide variety of experiences has been offered, the children may have considerable background for making interpretations and drawing conclusions. By this time they may be ready to read the summarizing statements given at the bottom of the page in order to verify their ideas with the book as an authentic source.

Plants grow in many places.
There are many kinds of plants.

Page 74 · Ideas about various places where plants grow are developed further in the book to provide an opportunity for making comparisons between plant environments. Boys and girls may refer to yards in their neighborhoods where they have observed situations similar to the one illustrated. It may be desirable to take a short walk or tour by school bus to see some of these yards.

Plants grow profusely in mountain meadows as well as around houses. When they are in bloom, it is particularly evident that a great variety of plants thrive in such a place. Some children may be able to share information they have about plants growing in a mountain environment. If so, encourage them to tell something about the variation in kinds and the great number of plants to be found in such a wilderness area. The illustration might prompt members of your group to look for magazine pictures which illustrate a mountain environment and add them to the bulletin board, chart, or scrapbook.

Page 75. Where Do Plants Grow Near You? This page is designed to lead children to recall experiences they have had in relation to different places plants grow and to help them summarize their learnings. The illustrations of plants of the garden, fields, roadsides, desert, and large city park may lead children to make associations and recall plant environments in their own neighborhoods, no matter where they live. As a result, the group may describe many situations in answering the question used as the title of the page. The pictures which the boys and girls may have organized on charts or the bulletin board also can be

used in summarizing ideas. When reading the text on the page, there will be an opportunity to compare and check their conclusions with an authentic reference.

Materials Needed

For use with *Science Near You*:

- calcimine paints
- discarded magazines
- newsprint, 18″ × 24″
- seed catalogues

For use with Further Experiences:

- calcimine paints
- chalk
- glass container for terrarium
- plants with much soil around roots
- rocks
- sand
- wood scraps or blocks
- wrapping paper, heavy, wide

Further Experiences

Making a Map · In order to help clarify concepts, encourage more observations, and develop spatial relationships, a teacher may assist children in making a map of a walk they have taken. They need an opportunity to organize a general plan for a map by first using sticks to scratch the route on the ground. They might use blocks or other pieces of wood to represent their school and the houses and other buildings along the route. They might also mark a few places where special observations were made. After this experience, the route can be sketched with chalk by the children on a long piece of heavy, wide wrapping paper. If they walked along two streets, two pieces of paper may be placed in an L shape. Plants along the street may be indicated roughly at this stage, and later the street and plants may be painted in with calcimine paint. It may be necessary to take the walk again for the purpose of verifying certain information and clarifying ideas.

A map experience helps to improve spatial concepts as children place things in relation to a point of reference. It also develops skill in observing, organizing ideas, and recording observations. From time to time the map may help children express themselves as they tell others about some event, such as a change in plants or buildings, which has taken place on the route. After a lapse of time the children might take this walk again to observe additional changes in certain plants. As a result, the group may wish to show these variations on the map. Such a map can become a helpful record for children who are interested in the changing conditions of plants.

Taking a Trip · It may be profitable for the children to take a trip in the school bus to gain a more extensive background concerning places

plants grow. If possible, take them to a good vantage point on a hill, or, if you are in a city, to a high building where they can get an overview of city or countryside. Such a trip should be planned carefully with the group. You might wish to invite some of the parents to go with you, thereby giving them an opportunity to see how you work with children on a study trip. They will also be able to assist you in various ways.

Making a Terrarium · The children may be interested in developing a terrarium which would illustrate one type of environment. There might be a need for setting up a desert situation or maybe a woodland habitat. It is important for children to consider first the advisability of removing plants from their outdoor habitat. If the situation warrants taking up the plants, then you will need to plan thoroughly with the boys and girls to provide a suitable indoor environment. Suggestions for setting up a terrarium are given in Chapter III of this Manual. During such an experience you may see evidence of boys and girls applying learnings as they make plans and build the terrarium. They may develop a more inquiring attitude toward the world around them. How are they attempting to solve their problems? How do they display intelligent behavior in assuming responsibility for their environment?

Seeing Variation in Trees · When considering the variety of trees in the schoolyard, children might paint large trees on wide, heavy, brown wrapping paper. After these are dry, they can be cut out and pinned on the bulletin board. The heights and shapes will give the effect of the wide variation in trees that are growing in the schoolyard. This experience may develop a need to look at particular trees a number of times at close range or from the window.

Visiting a Farm · It may be profitable for the group to visit a farm and have an interview with the farmer to answer some of the children's questions. They need to know that the farmer is an important resource of the community and that he knows much about growing plants.

Interviewing Informed People · A grandmother, the neighbor next door, or the custodian at school may be excellent gardeners and therefore important people to give explanations about plants.

Evaluation

In various places throughout this chapter in the Manual suggestions have been given for evaluating the behavior of children. Evaluation is a continuous process which you will be doing all the time with your group. You will be studying Ruth, for example, in terms of her potentialities, recalling what you know about Tom's background as you observe him, and anticipating what to expect from Betsy as a result of her changing attitude.

What evidence have the children shown of becoming more aware of plants growing around them? How do they display intelligent behavior in assuming responsibility for their environment? Are they growing in their ability to ask questions? What resources in the neighborhood have they used to gain information about plant growth? How have they shown an awareness of the desirability of seeking different sources of information? Some members of your group may have changed considerably in their behavior toward plants. At some later time, possibly a week or a month hence, you may observe more evidence of changing behavior which will reveal the value of experiences relating to plants.

Bibliography

For the Teacher

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 211–221. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 460–520. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition, pp. 75–76. Wm. C. Brown Company, 1955.

For the Children

Udry, Janice M. *A Tree Is Nice.* Harper & Brothers, 1956. Artistic illustrations and small amount of text make this a delightful book to use in emphasizing the value of trees.

Film

LITTLE GARDEN. (IF) 1 reel, b/w. Shows some of the conditions necessary for plant growth.

XII

How Plants Grow

This chapter about plants discusses a significant aspect of the child's environment. Plants growing around him develop in different ways and are affected by many factors. Numerous plants grow from seeds, but many start from roots and stems or other parts. Some plants flourish under certain conditions which are not conducive to the growth of others. Soil, water, and sunlight are among the factors affecting plant growth. In order to develop a working picture of these ideas, various situations are introduced in the book. Through these, children have an opportunity to find out that plants grow from seeds, roots, and stems. In addition, emphasis is given to the need of plants for sunlight, food, and water.

When studying your children to ascertain the concepts they hold and experiences they have had with plants, you will find that their backgrounds vary. As they react to the illustrations in this chapter there will be many opportunities to ask: What do you think? How can we find out? The results of such questioning might lead the children to set up problems and gain information through activities, such as experimenting, taking study trips, gardening, interviewing informed people, seeking books and pictures for additional information, and recording their findings for later reference.

Science Meanings for Children

Through experiences, such as those suggested here, children may be guided in their concept formation and in making interpretations about plants growing around the home and school. The following science meanings are developed in this chapter of *Science Near You*:

Some plants grow from seeds.
Some plants grow from parts of plants other than seeds.
Plants need water and sunlight.
Plants need food.
Plants change as they grow.

Gradually children may evolve ideas about the way plants are adapted to grow from seeds, roots, or stems. Additional experimentation may help them find that some grow from parts other than these. While caring for plants, there will be opportunities to observe interrelationships, that is, the relation of a plant to sunlight, water, and food. Changes which take place in plants can be easily observed by young children.

Through many sensory learnings while gardening, children deepen their concepts about soil and conditions necessary for plant growth.

U.S.D.A. Soil Conservation Service photo

The roots begin to grow, and the stem and leaves become taller and larger as they extend toward the sunlight. Time also is involved in plant growth. Children tend to develop time concepts as they watch their gardens grow, especially if they record their observations. From such experiences boys and girls may extend their concepts relating to larger ideas concerning time, change, adaptation, variety, and interrelationships.[1]

Information for the Teacher

Young children see plants growing in their houses, in yards, along streets, in parks, in the woods, and in many other places. These plants become taller and larger around. They bud, flower, leaf, and develop seed pods. The growth of bushes and trees is so gradual

[1]For further discussion of these patterns, see the Foreword, pp. xvi–xxiv.

that young children may think of these as always having been the same size. However, distinct differences in the growth of plants can be noticed as boys and girls observe the vegetables and flowers in their yards from time to time.

On occasions boys and girls help plant seeds, water plants, and pick flowers. Sometimes they see soil being prepared for planting. They observe people watering gardens and sprinkling lawns. Perhaps the results of a rain are noticed as plants begin to develop rapidly. Children not only see plants but they also eat them. The size, tenderness, and food value of plants are determined by the conditions under which they grow. As a result, children's food is affected by the way plants mature. Young children living in rural areas have many opportunities to become acquainted with the growth of plants as they help care for them, watch them mature, and hear people talk about working with them.

Pertinent material about plants and their growth is given here for teachers who wish more information. Additional ideas may be gained from the references suggested at the end of this chapter.

Many plants grow from seeds. Since squash seeds are used in the experiment on page 77 of *Science Near You,* the information given here is especially about the growth of this kind of seed, although many other plants, including beans, grow from seeds in a similar way. The covering of the squash seed holds the two halves of the seed together until the plant begins to grow. Food for the young plant is stored in the seed. It contains a sufficient amount of food to nourish the plant until it has grown enough leaves to carry on the food-making process. When a mature squash seed is kept moist and warm it begins to germinate. Roots are sent out first, and then the stem with the seed. The roots grow downward and the stem and leaves grow toward the sunlight. It is characteristic of squash, and also of the Lima bean, to push the seed up with the stem. In the process the seed loses its covering. Soon a different kind of leaf forms and, by the time several of these have grown, the seed leaves drop off because the food supply has been used.

Some plants grow from parts of plants other than seeds. A root, such as the sweet potato shown on page 78 of *Science Near You,* may start to grow. If partially covered with water, roots and stems will grow from the eyes, which are really buds. The potato contains food for the new plant. Some plants, such as geraniums and ivy, grow from stems. When a geranium cutting is placed in water, as shown on page 78 of the children's book, it sends out roots and begins to grow as an independent plant.

Various factors affect the growth of plants. Here we shall consider

the need for water, food, and sunlight. Water, which is essential for the growth of plants, is taken in through the tiny root hairs. By absorbing water, plants obtain food which has been dissolved from the soil. In addition, green plants are able to make some of their own food, which they use along with food from the soil. The amount of heat and light they receive also affects plants. Without light, green plants cannot produce food. Some plants do grow in dark places; however, their food is the decayed material of plants which once used light to make their own food. When green plants do not have sufficient sunlight, the leaves become pale green or yellow, as shown on page 79 of *Science Near You*.

Plants constantly change from the time they start growing. Growth takes place only in certain parts of plants, such as at the tips of roots and stems. Growth tissues located between the wood and bark cause growth in the diameter of the stem or trunk. These changes come about gradually as the plant matures.

Ways of Working with Children

"How Plants Grow" offers opportunities to learn about plants in home and school gardens, on the farm and in the city, and through experimentation. As children use the previous chapter they may become interested in some of the conditions necessary for the growth of plants. "How Plants Grow" might be introduced to extend these interests, develop an awareness of the way plants grow, and also motivate children to try experiments. On the other hand, the book might be used in connection with experiences children are having as they grow plants in the classroom, at home, or in the school garden. Suggestions for garden activities are included in Further Experiences.

Pages 76–81 · How Plants Grow

Some plants grow from seeds.

Page 76 · When planning and caring for a garden, there are innumerable opportunities to learn about ways plants grow and the factors which influence their development. Working with soil and plants provides satisfying sensory experiences which are most valuable to children in developing concepts and favorable attitudes. Guide a discussion about the picture so that conditions necessary for the growth of plants will be considered. You might ask: What did John, David, Ann, and Mary need to think about when deciding on a place for the garden? What do their plants need in order to grow? Why do you think the plants need good soil? What planning might these children have done before they started their garden? After such a discussion help your group read the text for the purpose of gaining an explanation of the illustration.

Plants need food, water, and sunlight.
Plants change as they grow.

Page 77. Experiments with Plants · If children have been working with plants, they may have raised questions and perhaps suggested experiments to help them obtain information. Experimentation affords various sensory experiences and may help clarify concepts.

Encourage the boys and girls to look at all the pictures on the page in order to gain an over-all idea of Ann's experiment. Prompt them to speculate as to what Ann is doing and why she wants to do this experiment. Lead them to read the first two lines of text to check their ideas or hypotheses. Explain to them that Ann has rolled up a blue blotter and placed it in the glass. And then she poured a very small amount of water into the glass. Do the children know how the seeds will be kept moist when they are at the top of the glass? After they discuss this problem, a child might demonstrate how a blotter absorbs water.

To begin the discussion of the third step in the experiment, ask questions such as: What parts of the squash plants have grown from seeds? In what directions are the roots, stem, and leaves growing? Why does Ann have the plants in the window?

As the children look at the last picture ask them to describe changes the plants have made. Motivate them to speculate how the plants grow so well without soil. What hypotheses do they set up? Lead them to test their hypotheses by reading the text at the bottom of the page and then discuss the explanation. By soaking a few large seeds, such as squash and Lima beans, the seed coat can be taken off easily and the two halves, called seed leaves, examined. Explain that the food for the young plant is stored in these two seed leaves. By using a magnifying glass, the children will be able to see the young plant as they examine the seed leaves.

As a result of studying the pictures, the children may develop an inquiring attitude toward the growth of plants from seeds. Do they wonder how long the squash seeds will grow without soil? Have they suggested doing the experiment themselves in order to find out? Have they thought of experimenting with other seeds to see if they will grow? For the best concept development it is advisable for children to try this experiment themselves. Encourage them to check their procedures and verify the results with those illustrated in *Science Near You.*

The children might plant various kinds of seeds in separate glasses to compare the growth changes. The seeds may grow very well. Some plants may develop blossoms and even seed pods. However, the stems and leaves will not be as sturdy as those on plants grown in soil.

When doing this experiment, it is important that the seeds be placed

near the top of the glass. If they are submerged in water, they will not grow because seeds require oxygen for germination. Keep the experiment in a warm place to encourage rapid growth. Sometimes mold forms, especially if seeds are not kept warm. Adding a few drops of a bleaching agent to the water will help prevent this condition.

Encourage children to anticipate what they think will happen and help them develop a willingness to check speculations after doing the experiment. Encourage a readiness on their part to change ideas as a result of new evidence.

Some plants grow from parts of plants other than seeds.

Page 78 · Ask boys and girls to tell about growing young plants at home. Some of them may have observed their parents starting new plants from slips. Some may have found sprouts on an Irish potato or had some experience in growing a sweet-potato vine. Maybe someone has seen an onion sprouting or sprigs of pussy willows sending out shoots. Possibly others have watched someone planting bulbs which later developed leaves and flowers.

Guide children in discussing the growth of the sweet-potato vine and questioning why it grows. What reasons do they give for their explanations? They can test their hypotheses by reading the text. Lead them to compare the growth of the potato with the growth of squash plants.

Prompt the children to look at Mary's experiment. What is she trying to find out? Help them read the text and answer the question at the bottom of the page. What concepts are they forming? How do they show ability to apply their learnings to this new situation? Which children show resourcefulness in suggesting similar experiments they might try? What purposes do they set up for doing their experiments? Who assumes responsibility for bringing some of the materials? It might be profitable to help the children keep records showing when they start the experiments, their observations from time to time, and questions they want to answer.

Plants need sunlight.

Page 79 · Encourage the children to speculate as to what Ann and the boys are finding out. Encourage them to question why the young grass plants are growing toward the window. Why is the grass yellow under the board? Some child may have made similar observations previously and tell about them. Guide the group to seek an explanation from the text and to verify their ideas of the reasons the plants appear as they do.

The children may wish to try similar experiments, such as planting

grass seed or some kind of grain in a flat, flowerpot, or tin can. As the plants grow observe the way they seek light. Ask the children to think what they might do to make the plants grow in the opposite direction. Turn the plants around and after a few days observe how they have turned toward the window again. When the plants are well started, place a small box or tin can over a portion of them. Leave it over the plants for a week or longer, but each day look to see if the color has changed.

Encourage children to consider what they might do that will cause the plants to become green again. Then take off the covering entirely. The children will see that the plants become green in a few days. It may be desirable to keep some kind of chart record of this experiment. The conclusions reached also might be given on the chart.

Plants need food, sunlight, and water.

Page 80. What Do Plants Need? Perhaps the children will need additional information. Interviews with a farmer, gardener, and nurseryman might be very profitable experiences in finding out how these people provide for the needs of plants.

David's father grows many plants on his farm. What do the children think these plants need in order to grow? What are their reasons for making such proposals? If some of the children live on farms where corn and wheat are grown, they may know a great deal about the needs of such plants and the way David's father must care for his plants. Some children may have seen a combine at work and be able to help other members of the group understand how it is used. Provide time for these children to contribute information about the growing and harvesting of such crops. Guide the group in reading the text to verify what they think are the needs of the plants.

Page 81. How Do These Plants Change? Help your group summarize their conclusions about ways plants change. Comparisons may be made as children study the illustrations of the garden shown at two different times. In answering the question at the top of the page, suggest that they consider how the plants of Ann's garden changed in height, kind of leaf, size of stem, and length of branch. Where do the children see flowers and fruit? What do they think Ann and her father must have done to help the plants grow so well?

When answering the question at the bottom of the page, motivate the children to recall changes observed in plants at home, on the way to school, and in the classroom. What changes have they noticed in relation to their experiments with plants?

Materials Needed

For use with *Science Near You*:

- blotter
- flat
- geranium slip
- glass
- grass seed
- jar
- jelly glass
- magnifying glass
- small board
- squash seeds
- sweet potato

For use with Further Experiences:

- calcimine paints
- cloth
- cotton
- garden tools, substantial and appropriate size for young children
- newsprint, 18″ × 24″
- pans, 3
- sawdust
- seed catalogues
- seeds
- sponge
- stakes
- string
- wrapping paper, heavy, wide

Further Experiences

Experimenting with Seeds · Place seeds between two layers of cotton which are kept slightly moist in a pan. Watch to find out if all the seeds germinate. Another way to experiment with seeds is to sprinkle different kinds in a sponge and place it in a pan containing a small amount of water. Observe when and how the seeds start to grow. A third experiment can be done by placing seeds on a piece of cloth which is laid over a layer of wet sawdust in a pan. Cover with another piece of cloth and more wet sawdust. Germination of the seeds can be observed by lifting the top piece of cloth.

Observing Changes in Plants · Plan with children to go for a walk and observe plant growth. At a later time, go again to observe changes in the same plants.

Another experience pointing up the pattern of time as well as of change may involve a picture record of a certain tree which is near the classroom. As the tree shows distinct changes during the year paintings might be made and mounted on charts with the dates and statements regarding the appearance of the tree. If all the charts are compared, there will be an opportunity for the children to draw conclusions about some changes that took place in the tree.

Making a Garden · It is desirable to select a garden plot near the classroom, making it possible for only a few children to work at one time in carrying out plans of the group. It is important that the size of the garden be in keeping with the ability of the children to care for it. A small garden provides many experiences and at the same time it does not tax boys and girls beyond their physical strength or fleeting interests.

Walk around the schoolyard with the group and look for a suitable place to have a garden. Of course, you will need first to consult with the school principal about the location so that you know where a garden will not interfere with other plans for using the grounds. Lead the children to talk about factors necessary for plant growth. These can be kept in mind as they look over the yard. Since most plants suitable for a school garden require much sunlight, this factor should be considered when selecting a plot. Also, you will need to have water nearby for watering the plants.

If you need help in determining whether the soil is suitable, you and the children might interview someone at school or in the neighborhood who is informed on gardening, such as a parent, custodian, teacher, principal, or nurseryman. By doing so, the children may see the importance of going to an informed person in order to gain information. If the boys and girls have an opportunity to watch a man add fertilizer and spade the plot, they may grow in their awareness of the importance of good soil for a garden.

Thorough planning is necessary when making a garden. As the children suggest plants they wish to grow they will need guidance in making their choices. It is most important that young children have a feeling of success within a short period of time. Therefore it will be wise to plant seeds which will mature rapidly, such as radishes and lettuce. Also it is advisable to select plants that develop before summer vacation, so the children can see them mature and have the experience of harvesting them.

To clarify plans for the garden, the children might be helped in making a map of their plot. When deciding where the different seeds are to be planted, the children might use sticks to roughly scratch out the rows in their plot. These plans can be mapped out on a large piece of paper placed on the floor. The rows might be painted to represent kinds of plants. Or the children might paint brown lines representing the rows and at the end of each paste a picture cut from a seed catalogue to designate the kind of seed planted. On the map they will need to place some point of reference, such as the side of the building or the fence, in order to orient themselves when referring to it.

In preparation for planting, the children will need to tie a string between the two stakes which mark the ends of each row. The children can make small furrows under each string, then plant and cover their seeds. A record of the planting might be kept by writing the date on the map.

Later, after some of the plants have come up, the children might make another map to show the progress of the plants. For instance, some

rows might be painted green to show plant growth, and the other rows might be painted brown to represent the soil where no plants appear. If the date is added, the concept of time might be emphasized. It will be evident that some plants grow faster than others. There may be value in helping the children make several records of this type.

There are other methods of recording plant growth in a garden. The calendar can be used for this purpose. A concept of time may be developed as children draw symbols on the calendar to record their activities and observations. By counting the days, they can determine how long it took their plants to come up and how often they needed to weed them.

It will be necessary to water the garden at various times. It may be advisable for the boys and girls to keep a record to show when it rained and when it was necessary for them to sprinkle or irrigate their plants. The record might be kept on the calendar or on a chart.

Besides recording the rainy days, the children may mark the days when it is sunny and when it is very cloudy. Such an activity calls attention to the science meaning that plants need sunlight. Instead of using the calendar, a weather chart might be kept. The following charts offer suggestions:

Plants Need Sunlight
Plants Need Water

April 20
It rained all day.

April 21
It rained today.
The sun shone, too.

April 22
It is cloudy.

The Weather

April 20 — rain
April 21 — rain
sunny
April 22 — cloudy

A garden requires much care. In addition to planting and watering, it is necessary to pull weeds and loosen the soil occasionally. Many plants should grow from the seeds planted in each row. Weeds, which undoubtedly will come up between the rows, will need to be pulled. Hoes and trowels will be needed for loosening the soil around the plants.

The hoes should be substantial and of appropriate size for young children to handle.

For purposes of emphasizing and summarizing certain science meanings as the garden activities progress, it may be helpful to the children to keep a diary from day to day. This story might record their activities, what they find out about the growth of plants, and their questions and plans. Such a record may serve as a reference from time to time as the children observe results in their garden.

When the garden matures, the children will have many sensory experiences as they harvest their plants. Help them to notice how the plants have changed. Do they see where seeds are forming? Many experiential learnings may accompany the gathering of vegetables as well as the preparation of them for serving and eating. When these activities are carried on, do you hear and see spontaneous reactions which reveal concept development along the large patterns of adaptation, interrelationships, change, variety, time, and space?

Evaluation

The way your children spontaneously carry on their activities, ask questions, offer suggestions, work together in trying out their ideas, and apply their learnings to new situations will give you helpful clues in planning for their next experience. In what way is the behavior of some individuals changing as they search for an explanation to their questions about plant growth? Do some children reject guessing and faulty thinking? Who is improving in readiness to listen to the ideas of others? Some boys and girls may show added resourcefulness in carrying on their work. They may be gaining in ability to check conclusions and to change ideas as a result of new evidence.

When talking with parents, you may learn how some of the children are showing a special interest in working in home gardens. Such action serves as a test of the degree to which children value the experiences you offer them.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 460–520. Ginn and Company, 1958.

Greenlee, Julian. *Teaching Science to Children*, Revised Edition, pp. 71–77. Wm. C. Brown Company, 1955.

For the Children

Downer, Mary L. *The Flower*. William R. Scott, Inc., 1955. Both text and illustrations interestingly depict how a flower seed grows, blossoms, and develops seeds for future flowers.

Israel, Marion. *Tractor on the Farm.* Melmont Publishers, 1957. A delightful book which presents factual material related to operations of the tractor, plow, harrow, drag, and seeder.

Krauss, Ruth. *The Carrot Seed.* Harper & Brothers, 1945. Full-page drawings and brief text tell how a boy plants a carrot seed and how he cares for the plant.

Podendorf, Illa. *True Book of Trees.* See the Bibliography for Chapter XI.

Selsam, Millicent E. *Play with Plants.* William Morrow and Company, Inc., 1949. A book of experiments written for older children but recommended for teacher background concerning ways plants grow from seeds, roots, stems, and leaves; how plants develop; and what they need.

Webber, Irma E. *Up Above and Down Below.* William R. Scott, Inc., New York, 1943. Information provided through simple text and pictures about growth of plants and the relationship between plants and animals.

Zim, Herbert S. *What's Inside of Plants?* William Morrow and Company, Inc., 1952. Clear, detailed drawings in color and descriptive text, both in simple style with large print and in more complex style with smaller type. The latter provides information for teacher's background.

Film

WONDERS OF PLANT GROWTH. (C-W) 1 reel, color and b/w. Two children grow plants from seeds, a stem, leaf, and root. Plant growth is shown in time-lapse photography.

Filmstrips

PLANTS GROW. (JH) color.
TREES GROW. (JH) color.
VEGETABLES FOR THE CITY. (CurrF) color.

XIII

The Soil

Soil affects the lives of all people, of adults and of boys and girls. The plants they eat have grown in the soil. Their meat comes from animals which have converted plants into food. The soil has produced plants which have been used to supply some of the material for their clothing. Soil is one of the most important resources in our modern world. The future of all people, those in the city as well as in rural areas, is dependent upon it. Their welfare is tied up with the way soil is used and maintained.

Because the loss of soil has become such a critical problem, it is essential that all individuals early in life establish a feeling of responsibility for it. Therefore, it is important that children develop an awareness of the soil around them and the conditions that affect it. Boys and girls in urban areas, as well as those in rural communities, should learn the importance of soil and how people need to use it.

In order to alert children to erosion of the soil around them, the book introduces a situation which shows the concern of children and their teacher for loss of soil. They not only observe soil being washed away but they also do something about it. Members of your group might be able to stop erosion in their schoolyard in a similar manner. Besides preventing water from washing away the soil, boys and girls can find out why plants and rocks are used to hold it. Water is not the only eroding agent. City children as well as those in rural areas experience wind blowing dust around them. In some areas boys and girls may see soil piled up near roadsides or in sand dunes along beaches. As children use this section of *Science Near You* they may develop a feeling of concern for the soil they see near them.

Science Meanings for Children

This Manual offers suggestions for helping children take some responsibility for the soil around them as well as develop

meanings along several large basic patterns or ideas. For instance, there will be opportunities to help children adjust to the pattern of change as they observe such changes as water carrying away soil, or wind blowing it away. Gradually boys and girls may develop ideas about interrelationships and balance as they experience soil being carried away by water and wind and also as they use plants and rocks to hold soil in place. When they examine the root systems of plants, learnings may evolve about the adaptations of plants for holding soil.

As the children develop the following science meanings they may gain ideas relating to aspects of change, adaptation, interrelationships, and balance:[1]

Water can wash away soil.
Rocks and plants can help to hold soil.
People can stop water from washing away soil.
Wind can blow away soil.
People can stop wind from blowing away soil.

Learning about conservation, or the intelligent use of natural resources, includes not only becoming familiar with a body of content but it also involves a way of behaving. Before digging up plants, boys and girls should be helped to consider if these should be taken from the environment. What do they think might happen to the soil during a rain if the plants are removed? What might the children do to prevent the soil from being washed away near their classroom? As you use this chapter of the book there will be occasions to stimulate thinking and to develop intelligent behavior about the use of soil. By actually seeing erosion in some places, children will have an opportunity to find out what happens when people disturb soil, dig up plants, and allow gullies to form. As boys and girls carry on the kinds of experiences suggested here they may show evidence of developing a feeling of responsibility toward the soil.

Some very large ideas are developed in the chapter. Therefore, children need time to think through what they find out, to rework ideas in their own minds, to internalize a new learning, and to integrate it with their own experiences and ideas so that the concepts will become acceptable to them. Frequently an adult proceeds too rapidly. Just because he understands the content, he feels that the child also understands and therefore moves on too quickly. It takes time for a child to formulate concepts.

[1]For further discussion of these patterns, see the Foreword, pp. xviii–xxi, xxiii–xxv.

Information for the Teacher

Two- and three-year-olds like to dig in soil, making holes and mounds as they play. The soil may feel gritty to them; sometimes it feels coarse; and sometimes it seems fine and smooth. They like to walk in soft mud, feeling its stickiness and the sensation of it squashing between their toes. As he digs the five-year-old may find that soil contains sticks, parts of leaves, and little pieces of rock material. Sometimes he comes upon earthworms and other small animals. The six-year-old likes the same activities. When he grows plants, he finds out more about the soil around him. He sees and feels dust in the air as it blows around him. It gets into his eyes. Sharp grains of sand sting his face. He tastes it as it blows into his mouth; he feels the grittiness of it in his ears.

The young child tends to think of soil as that which is under his feet. It is something he walks on and is under the grass. He may call it "dirt" or "ground" or "earth." These are significant words in the child's vocabulary. A feeling of stability or firmness comes from the ground. Buildings are constructed on it; the child can walk on it; big trucks run on it; and it supports large trees.

Some young children are encouraged by parents and teachers to participate in gardening activities. Soil begins to take on more meaning as it is prepared for planting, when it is watered and cultivated, and as the growth of plants is observed. Children discover for themselves that soil is a habitat for animals. They may find a number of animals in the soil as they care for their garden. Holes may be found in the lawn, in the meadow, or in the woods, which are entrances to homes occupied by various animals.

When your children come to school, they may bring with them a wide background of experiences concerning the soil. Using *Science Near You* may enlarge and extend their learnings. Additional information relating to that in the textbook is given here if you wish to use it.

When soil does not have a covering of plants, it is easily eroded by water. Rapidly flowing water cuts away soil very quickly. If you live near a creek, you may have noticed how the water wears away its banks, especially during floods, and carries soil away. Or if you live near a swift mountain stream, you may observe the water rapidly erode soil in its path. As a result, the canyon is cut deeper from year to year. You may live near a wide river which carries tons of soil to the ocean. The water appears very muddy in such rivers. During a hard rain you may have observed much loss of soil even from comparatively level areas. Each year flood waters move a tremendous quantity of soil as they flow over the land.

Many children live in large cities, and there, too, erosion takes place. After a rainstorm they can see places where soil has been moved away from the sidewalk, how muddy water rushes down the street, and possibly where depressions may have been made in a nearby park.

Wind also moves much soil. Have your children experienced dust storms? What was the source of the dust? Did it come from an excavation in the next city block? Was it blown off fields near your school or from a highway cut nearby? When plants have been removed from the land, wind blows the soil about and gradually the rich topsoil disappears. Some children live in places where dust storms have caused much destruction of farm lands.

Plants are used as a protective cover to prevent erosion of soil. Many grass plants tend to bind soil in place because they have a spreading root system and grow close together. Other plants with similar root systems also offer good soil protection. A heavy cover of plants helps to prevent loss of soil by both wind and water. Children living in both urban and rural communities have opportunities to see plantings in yards, parks, and along highways. They may be able to see an eroded area alongside one that has a cover of plants. If so, comparisons can be made.

Rocks also tend to hold soil in place. When they are put in a gully, the soil builds up back of them and fills in the area. Then, if grass seed or other plantings are made around the rocks, the soil is held in place by many roots and a protective cover is created. Rocks are used for walls and dams in order to prevent soil from eroding.

Conservation of soil, one of our most valuable resources, needs to be considered in terms of intelligent use. How is the soil being used in your community? Are gullies forming as a result of water erosion? Do you experience dust storms? What control practices are being used along highway cuts and streets, in parks, yards, and fields? People in both city and country have a responsibility to keep a cover of plants on the soil or to cultivate it in such a way that there is little loss of soil by water and wind. You can help children prevent erosion as they care for their garden or as they seed an eroded area in the schoolyard. By doing so, they may develop a concern for the soil and a constructive way of behaving toward it.

Ways of Working with Children

The chapter can be introduced to help boys and girls become aware of soil erosion in their neighborhood. They might be motivated to ask questions and make comments about similar conditions in their environment. Help them feel free to tell about the observations they have made at home or on the way to school. As a result, members

of the group will gain much information from each other. Such sharing of experiences might lead them to visit some of the places which have been described. If so, there will be an opportunity to build associations which will reinforce the ideas presented in *Science Near You.*

The book might be used when your boys and girls want to find out what they can do to stop erosion in their schoolyard. As they see what Ann and the boys do to stop water from washing away the soil they might make similar plans. Or the chapter might be introduced after children have encountered a dust storm. As a result they may become aware of wind erosion as well as water erosion.

Los Angeles County Schools

These children became concerned about erosion in their schoolyard and considered what they might do to remedy the situation.

Then, too, this chapter could be used profitably in connection with an observation you and the children make together. For instance, on a study trip you may see from the bus windows a badly eroded hillside along the highway. The children may make comments about it and ask questions. Material in this chapter will carry special meaning for the group after such an observation.

Pages 82–87 · The Soil

Water can wash away soil.

Page 82 · The purpose of the picture is to alert children to the problem of soil being washed away by water. Discuss the observations which

Ann and the boys might be making as they watch the gully being formed. You might ask: Why do you think Ann and the boys are concerned about the water? How does the water look? Encourage your group to speculate concerning the following questions: Do you think the water is running down the hill fast or slowly? Why do you think the soil is being washed down the hill? Through such questions it is possible to emphasize the science meaning that water can wash away soil.

This situation might prompt the group to suggest what Ann and the boys could do to stop the soil from being washed away. Provide time for comments and suggestions before going on to the next page.

Some children may be reminded of similar situations they have seen. As they tell of their observations lead them to focus on the way water cut into the soil, its muddy appearance, and whether the water was running fast or slowly. Motivate them to consider how the damage they saw might affect the growth of plants, make it possible for more soil to be washed away at a later time, and cause work for people.

During discussion you can assist children in developing an oral vocabulary which may make it possible for them to read the text easily. As a result of the discussion the children may become sufficiently interested in the soil to read the text with the conscious purpose of finding answers to their questions and of verifying some of their proposals. Help them read the text and discuss what they find out.

Encourage children to look around the schoolyard to see if they can find places where soil has been washed away. Compare this area with a grassy plot nearby.

Perhaps children will have observed soil erosion around their homes. Provide time for them to tell of these observations, ask questions, and give their reactions. What interpretations are they making? Are they developing the beginnings of ideas concerning the patterns of change, interrelationships, and balance?

Rocks and plants hold soil.

Page 83 · If your children have made a number of observations and spent considerable time discussing the way water washes away soil, they will bring much meaning to the page. Their questions, speculations, and interpretations concerning page 82 will also provide background for discussing the procedures shown in the pictures. These situations are designed to give children detailed information about ways in which people can stop erosion and what might be done in their own schoolyard if it has a small eroded area.

It is important that children not be hurried in their concept development; therefore it is suggested that you do not move over these pages too rapidly. The work of Miss Mills, Ann, and the boys will mean much

to your group if they have time to think through what they have found out and are given an opportunity to internalize their learnings.

Guide the group in suggesting why Miss Mills and the children are placing rocks in the gully and sprinkling grass seed around them. Help your boys and girls read to gain an explanation. Some of them may read the text easily if the oral vocabulary has been developed when talking about the illustrations. Encourage discussion of the information given.

Where have your children seen grass holding soil? Where have they seen rocks holding soil? Lead them to consider why plants and rocks can hold soil. To clarify concepts and to apply what they have found out here, your group might carry on a similar activity if erosion is taking place in the schoolyard. Of course, you would want to be sure that the solution of the problem is within their range of ability. (For other suggestions see Further Experiences.)

People can stop water from washing away soil.

Page 84 · This page illustrates the meaning that people can stop water from washing away soil. Guide the children in their interpretation of the illustration by calling attention to the growth of grass around the rocks. Encourage them to discuss the fact that no soil is being washed away and, also, the way in which the children and Miss Mills have helped to stop the erosion. Through such a discussion your group will have an opportunity to develop the science meaning involved here and grow in their understanding of the large patterns of change and interrelationships.

Help children read the text to find the conclusions reached by Ann, John, and Miss Mills. What reactions are given by the group, especially to the statement made by Miss Mills? Why do your children think they need soil around them?

Plants hold soil.

Page 85. Grass Plants Hold Soil · This page is designed to show why plants hold soil; therefore roots of the grass plants as well as leaves above the ground are pictured. By reading the text and studying the drawings children may see how root systems bind soil together. Help them dig up a few grass plants and several different kinds of weeds. Examine the root systems and see why some of them hold soil. The children will need your guidance in selecting a place where the environment will not be disturbed much if these plants are taken out. Also, lead the group to consider where they have a right to remove plants.

As the children examine grass plants bound together encourage them to observe the number of roots and the amount of soil clinging to the roots. This observation might help them see why many grass plants

grow close together above the ground. Prompt the children to single out one plant and shake off the soil in order to study the root system. If a magnifying glass is available, it will aid in examining the plant. These specimens might be compared to the grass plants illustrated in the book.

Wind can blow away soil.
People can stop wind from blowing away soil.

Page 86 · This page illustrates how wind erodes soil and what people can do to prevent such erosion. Encourage children to tell about their experiences in a dust storm. Help them recall the appearance of dust in the air, the taste of it, and how it felt as it hit the skin. How might they feel if they were the children in the picture at the top of the page? Where is the soil coming from? Why can the wind blow it away? Help them read the explanation and encourage discussion of it.

Lead the children to question what the men in the picture at the bottom of the page are doing and why they are doing it. Help the group to verify their ideas by reading the explanation. Encourage a discussion of what they find out. Do some children refer to their own observations of plantings along a highway cut? Do they suggest looking for places similar to the one shown here? Plan with them to observe places where wind can erode soil and where plants prevent erosion. Through such experiences there will be an opportunity to develop the meaning that people can stop wind from blowing away soil.

Page 87. What Holds Soil Near Your Home? This page is planned to help children summarize their ideas and apply them to situations where they live. The illustrations of water and wind erosion may remind the children of similar places they have seen. After they read the line of text in the middle of the page, plan with them to carry out the suggestion it makes. Offer the children an opportunity to tell the group about their observations.

By looking at the next picture the children may be reminded of rock walls they have seen which held soil so that plants could grow. The fields in the fourth picture may help them recall how plants hold soil. Guide them in reading the text to verify their conclusions.

Materials Needed

For use with *Science Near You*:

grass seed
magnifying glass
plants
rocks

For use with Further Experiences:

garden hose
grass seed
jar

Further Experiences

Determining Amount of Soil in Water · If possible, go to a place where muddy water is flowing and dip some of it into a jar. As the children observe the water in the jar they will see particles of soil. Let it stand until the next day and observe the sediment that settles to the bottom. As a result, the children can see how much soil was being carried by the water.

Observing Soil Erosion · Is there a location near the school where your group might see places which show a loss of soil? Some children may have suggested places which they see as they go to and from school. Walk with the group to study one or two of these which are a short distance away. Motivate the children to imagine what the place must be like when it is raining. Lead them to think why the water washes away the soil there but not from a grassy place close to it.

Seeing How Plants Hold Soil in Place · To help children gain information and clarify concepts about plants holding soil, you might use a hose to run a small amount of water over grass and then over a place where there is no grass. The children can observe the water spreading out over the grass and sinking into the ground. Where there is no grass, they will see soil, pebbles, leaves, and sticks being moved by the water.

Stopping Erosion · The situation on page 83 might lead your children to have a similar experience if there is a small gully on the school grounds. Plan with the group where to get rocks and grass seed. The custodian might have grass seed which they can use. Lead the children to check their procedures with those shown in the book. Anticipate what might happen during the first rainstorm. Plan to observe frequently and notice the growth of the grass and possibly the loss of soil. If your children carry out this experience, notice in what ways it helps them in their concept formation. What attitudes do they develop?

Evaluation

In thinking of conservation as a kind of behavior, how do your children show that they feel a responsibility for soil near them? Do they make comments during a heavy rain or a dust storm which reveal their awareness of the problem? Are they talking over their ideas with their parents as well as with you? When have you noticed their learnings emerging in a creative expression, such as through their paintings?

Some children may have become especially concerned with this problem of soil erosion. Members of your group will vary greatly in their development. Which ones are showing an inquiring attitude, not only about soil, but about other phases of the environment as well? Which ones have improved in helping the group set up proposals? Who shows

much readiness to check information by referring to the book or an informed person? Which children have shown progress in drawing pertinent conclusions? Your evaluation of their behavior will offer clues for further planning.

Bibliography

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 286–309, 487–520. Ginn and Company, 1958.

For the Children

Smith, F. C. *The First Book of Conservation*. Franklin Watts, Inc., 1954. Explains some of the ways man is conserving natural resources. A teacher may find this reference helpful even though it is designed for older children.

XIV

Animals and Plants

Man has domesticated many animals and must give them considerable care. He also has a responsibility to protect wildlife in the natural habitats remaining for them. The same is true for plants. Man must give time and effort to caring for animals and plants, but he is well rewarded because he receives many benefits from them. They serve as valuable foods in his diet, they supply him with clothing, the attractiveness of the out-of-doors is improved by them, and they contribute to his pleasures in many ways.

Besides these values, plants and animals help to maintain a balance in the world. Snakes and hawks tend to keep in check many of the smaller animals. Birds and spiders prey on insects. Coyotes keep rabbits and many rodents in check. Some animals eat grass and other plants. They also seek shelter and shade under bushes and trees. Plants are most valuable in holding soil in place so that water and wind will cause less erosion. Thus goes on the endless chain of interrelationships, all of which eventually benefit people.

The farmer cares for his cows by milking them, providing them with water and food, and with shelter when needed. Pets need care, too. Many young children take some responsibility in caring for their pets, possibly giving them water, food, exercise, or a brushing. Sometimes boys and girls participate with other members of the family in constructing a shelter or giving them a bath. Children may also take part in the care of plants around their homes, as shown in *Science Near You*. They frequently comment about helping mother or father plant seeds, pull weeds, water flowers, and pick fruits and vegetables.

Besides caring for their own pets and farm animals, people have a responsibility for the wildlife in their neighborhood. A birdbath, birdhouse, or feeder encourages many birds to come to a yard where they offer enjoyment to the people living there. In many places people help animals by providing a cover of native plants along busy

highways. If plants are allowed to grow, eventually animals seek protection there. As shown on page 91 of the children's book, many farmers make ponds on their farms where wild plants may grow and give cover for animals that ordinarily live in such an environment.

***Science Near You* may be used to develop desirable behavior in relation to picking wild flowers. Frequently adults, as well as children, thoughtlessly gather large quantities of wild flowers without realizing how they are disturbing the environment. Favorable attitudes and a feeling of responsibility toward the environment may be developed by children as their understanding grows concerning plants and animals.**

The situations presented in the book may lead children to assume more responsibility for the care of their pets. It might stimulate them to encourage birds to come near their homes or school by putting out water and food and offering protection. Possibly the children will be prompted to find out more about the needs of other animals in the community. Also they might develop more concern for plants in their yards and along the streets. Perhaps they will plan with you to have a school garden.

Science Meanings for Children

The following science meanings are developed in this chapter of the book:

People need to care for animals.
People need to care for plants.

If children have opportunities to look after animals and plants, they may gradually gain ideas about their responsibilities to the environment. They may come to see the interrelationships among living things, especially the part man has in using his resources wisely in relation to their value to him. Some beginning ideas may be gained concerning balance in the environment and the obligations of people to care for plants and animals in maintaining this equilibrium. Here again is a place where young children may extend their concepts regarding the basic patterns of interrelationships and balance.[1]

[1]For further discussion of these patterns, see the Foreword, pp. xxiii–xxv.

Information for the Teacher

At an early age children have a variety of experiences with animals and plants. The activities of the family in looking after the pet dog or cat are observed by the two- or three-year-old. The four-year-old may like to help feed the goldfish or canary. Frequently he may watch his mother and father caring for plants in the yard. A child living on a farm may have numerous experiences with animals and plants, and to a limited extent have a part in caring for some of them.

Many children have opportunities to see animals in woods, meadows, along highways, in streams, lakes, or tide pools along the coast. Sometimes boys and girls go to parks where there is wildlife, such as birds, squirrels, rabbits, fish, turtles, and frogs. Some animals may come to the children's yards or to vacant lots near their homes. Occasionally boys and girls see some of the ways people offer protection to wild animals.

Children may help to care for the plants in their gardens, yards, and classroom. However, young children usually give little thought to the care of wild plants growing around them. They admire the wild flowers and like to pick them, but may not show any concern for protecting them. Through guidance boys and girls can be helped to see the need for leaving wild flowers in the natural habitat. If no flowers are left, there will be no seeds. By careless, thoughtless picking some plants may become rare or even be eliminated.

When the children are discussing care of the animals and plants shown in their book, you may wish more information. For additional help other than that given here or in references at the end of the chapter, it is suggested that you refer to specialists in your community, such as a farmer, agricultural agent, nurseryman, veterinarian, pet-shop dealer, or parents who have special skills or information about animals and plants.

Care of Cows · The cattleman exercises great care in looking after his cows. It is important that their diet be balanced and that they be fed at regular intervals. He supplements the grass they eat in the pasture with hay and other kinds of feed. They need an adequate supply of clean water, and exercise and rest. The dairyman must be punctual in milking his cows, and he must keep the barn clean.

Care of Dogs · Children need guidance in helping care for their dogs. Of course, they will not assume much responsibility for the diet of their dogs; however, this information may help you in discussing what is considered a good diet. The health of a dog depends on the food he eats; therefore it is important to plan his diet. He lives principally on meat. It is impossible for his digestive system to convert many starches and

sugars into nourishment; thus his diet should not include sweets, potatoes, bread, or rice. Cooked beef and horse meat provide a good source of meat. When fed to the dog, it should be mixed with a dry cereal. This diet should be varied and supplemented with other foods. A hard-boiled egg can be served every other day. Cottage cheese, which is rich in protein, also might be given to the dog every other day. Cooked liver or canned fish is good to vary his diet once a week. Also some cooked vegetables, such as carrots, green beans, or tomatoes, might be used. Dog biscuits are good for his teeth and offer nourishment. Avoid giving small bones to a dog. Always keep fresh water in a place where he can get it. Some dogs prefer milk to water.

Besides being properly fed, a dog also requires grooming. He should be brushed two or three times a week to keep his coat clean and free from loose hairs, as well as to make him more comfortable. Occasionally a dog needs a bath in warm water and soap. He should be handled very carefully so that he is not frightened when being bathed.

Care of Rabbits · Since rabbits eat a variety of foods, it is easy to care for them. Their daily menu should be a combination of grains, proteins, and roughage. The commercial rabbit pellets provide a balanced diet of these foods. Some fresh foods may be sparingly served each day, such as lawn clippings, lettuce, celery, turnips, carrots, parsnips, or other green vegetables. It is best to feed rabbits in the early evening because they are active at night. However, some people feed them twice a day, giving them fresh greens in the morning and feeding them pellets or grain and hay in the evening. Rabbits drink a considerable amount of water. The water dish should be washed each day and fresh water given them every morning.

It is important that rabbits be housed in a hutch which can be cleaned easily. They should be kept outdoors as long as the weather permits and in a place where there is part sun and part shade so they can be in a sunny or shady place as they wish.

Protection of Wildlife · People are beginning to realize that wildlife constitutes one of the very important natural resources. Various laws are being enforced to protect wildlife, and many refuges have been established.

Where do children see wildlife in your community? Is there a game refuge or bird sanctuary in the area? Maybe some animals seek refuge in the neighborhood. Perhaps some people near the school are interested in attracting birds to their yards and give you and the children permission to visit there. There may be a wooded area close to the school where young children see birds, squirrels, rabbits, snakes, and many insects.

Possibly your children live near a desert where they see birds and other animals adapted to living in an arid or semiarid region. They may see lizards, snakes, desert tortoises, jack rabbits, pocket mice, and insects.

If you are in a community along the ocean, there will be a very different kind of wildlife for the children to observe. They may become acquainted not only with fish, but also with crabs, starfish, mussels, snails, sea urchins, and shore birds.

What is being done in your community to protect the wildlife there? Perhaps the highway department is retaining some of the natural cover along highways so that birds and other small animals seek refuge there. The ringnecked pheasant and gray squirrel are shown in this type of environment on page 91 of *Science Near You.* If you live in a farming area, possibly you know some farmers who are developing ponds in protected areas where animals may live? As plants grow up around the ponds animals tend to go there for water. Some animals may select these areas for their homes. Sometimes people plant fish in the ponds. You may learn of other practices which are being used in your neighborhood to protect the wildlife.

Care of Cultivated Plants · People in cities, as well as in rural areas, give much care to plants in their houses, gardens, and yards. Many people make a business of raising plants. Are there truck farms in your community? Are flowers being raised there to be sold on the market as cut flowers or possibly for seed? Perhaps fruit or nut trees are grown near your school. What opportunities do children in your group have to learn about the care of these plants? Farmers and nurserymen will have information about local conditions.

People who raise plants study their growth and the conditions affecting them. It is important to be sure plants have the proper kind of soil and that it is carefully prepared. People must sow good seeds, be ready to water the plants if there is insufficient rainfall, keep the soil in proper condition, and control the growth of weeds. Sometimes plants need to be treated for insect pests and plant diseases. Later, when plants mature, people need to exercise care in harvesting them.

Protection of Native Plants · What is being done in your community to protect native plants? A forester, agricultural agent, or nurseryman may be able to give you information about the local situation. Many forested lands have been set aside as protected areas. State and national parks are making it possible for people to enjoy native plants. Much effort is being made to protect forests against fire. Laws have been passed making it unlawful to pick flowers or dig up plants in many places. Young children may be helped to realize the need for protecting and caring for these native plants as well as those in their gardens.

Ways of Working with Children

The chapter on "Animals and Plants" may help children think through much of the information they have gained about animals and plants while using *Science and You* and *Science Near You.* Now they will have an opportunity to consider their part in the interrelationships of plants and animals.

The chapter might be introduced in connection with an everyday experience. Perhaps a child tells about his pet or the way he cares for animals or plants at home, thus stimulating interest on the part of other children. Or the chapter might be used to further activities started as a result of using another part of the book. Also, it might be introduced for the purpose of developing an awareness concerning care of animals and plants.

A pet rabbit brought to school one day helped the children extend their ideas about the care of animals.

Alhambra City School District, Alhambra, California

Pages 88–95 · Animals and Plants

People need to care for animals.

Page 88 · As children tell about experiences with cows and dogs lead them to consider ways in which people need to care for these animals. Prompt them to discuss where David and Patsy may have gone for the cows. If any of your children have had a similar experience, give them

time to tell about it. How did their dog help them and how did they care for the dog when getting their cows? Lead them to anticipate how David's father might care for the cows. Encourage boys and girls to discuss the plants growing in the garden. How is David's brother caring for them? What other care must be given the garden?

People need to care for animals.

Page 89 · After the boys and girls discuss the way David's father is caring for his cows, help them read the text to find out what cows need. Lead the group to think of ways people look after cows, calling attention to the great care given to feeding cows a good diet, furnishing a sufficient amount of water, and keeping the barn clean.

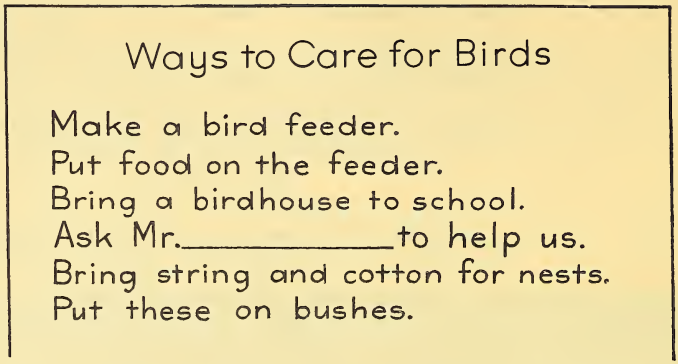
After looking at the illustrations at the bottom of the page, help the children read the text to find out about David and his dog. Provide time for the children who have dogs to paint pictures showing how they care for them. Through discussion and their paintings, do they show that they have some realization of the importance of proper diet, water, and a regular time for feeding a dog? Do they refer to a dog's need for grooming, activity, and rest periods?

People need to care for animals.

Page 90 · Some children may have had experiences with domesticated rabbits and be able to offer information about their care. After they look at the illustration at the top of the page and read the text, lead the children to discuss why the rabbits' home is a good one. Consider ways in which Ann and her father care for the rabbits. Focus on their need for a good diet, regular time for feeding, fresh water, clean hutch, exercise, rest, and careful handling.

As the boys and girls look at the illustration at the bottom of the page and read the text encourage them to tell how they have helped birds. Prompt them to discuss how people put up birdhouses and birdbaths so that birds will come near their homes. Notice how those in the picture have been placed where plants offer protection. Birds fly into nearby trees and wait until it is safe for them to go into a birdhouse or take a bath. Where have the children seen birdhouses and birdbaths? Encourage them to tell of such experiences, ask questions, and give reactions to the contributions of other children.

In order to find out more about birds, the group might take a walk to see how someone in the neighborhood cares for birds around his home. This experience might stimulate the children to ask: What can we do for birds near school? What can we do so that birds will come near our houses? Together the group might make plans which need to be recorded


Ways to Care for Birds
Make a bird feeder.
Put food on the feeder.
Bring a birdhouse to school.
Ask Mr._____to help us.
Bring string and cotton for nests.
Put these on bushes.

on a chart for further reference. The chart above is suggestive.

If boys and girls have an opportunity to participate in various activities, they may become much interested in birds and in helping protect them. These experiences may lead children to become concerned about other wildlife in their community and in ways of protecting it.

People need to care for animals.

Page 91 · After studying the illustration at the top of the page, guide children in reading to find out how people help animals in this situation. Help the children see that people protect wildlife by leaving a cover of grasses, bushes, and trees along highways. Encourage children to discuss why they think the pheasant and squirrel live in this place. What is the danger of living so near a highway? Interest them in looking for places near highways where animals might be living.

Help the group consider why animals and plants live at the pond. Encourage them to tell about small ponds they have seen where plants and animals were living. Help them read the text for the purpose of finding out why people make ponds on their farms and discuss the explanation given. Note what animals are living there. Lead the children to speculate as to what other kinds of animals might live there even though they are not shown in the picture.

To find out more about animals and plants living around ponds, take the children to see such an area. Look for animals around the pond and for places where they might find protection.

People need to care for plants.

Page 92. Care of Plants · After children look at the two pictures at the top of the page, lead them to read and answer the question under them. Help them bring out the idea that Ann is giving the plant soil from which it will get food. Ann is also giving the plant water and

placing it in the sunlight. If a child has helped someone pot plants, encourage him to share his experience with the group.

Guide the children in reading the text and help them discuss the way Ann and her mother care for the plants. In answering the question at the bottom of the page, children might make large chalk pictures showing the way they help care for plants. Provide time for them to tell about their pictures. How do they care for plants in the house, in the flower garden, in the vegetable garden, and possibly in other places? As a result of sharing ideas, the children may draw the conclusion that people care for plants in many ways.

Children may wish to have plants of their own to look after. Several children may bring plants for the classroom. Also, the group might have a garden, as was suggested under Further Experiences in the chapter "How Plants Grow."

People need to care for plants.

Page 93 · Help children read the text and guide their discussion of ways in which the men care for the orange trees. In areas where the soil is dry, orange trees need to be watered. This is done by running water into irrigation ditches between the rows of trees. Also the trees need to be protected from destructive insects and diseases. Therefore, the men use a machine to spray the trees with insecticide. Many children will not have seen an orange tree. However, they may have seen men caring for other kinds of fruit trees. They may see trees in their neighborhood being planted, trimmed, sprayed, and watered. Therefore, they may be ready to tell how people care for trees. Sometimes children have an opportunity to participate in planting a small tree in the schoolyard. Such an experience might create much interest and result in a concern for the care of trees.

People need to care for plants.

Page 94 · This page is designed to help children see the importance of leaving wild flowers in the natural habitats. Too frequently many wild flowers are picked and then discarded very quickly. The flowers should be left to mature so that more plants may grow the next year. Lead the children to speculate as to what might happen if people picked all the flowers in the meadow. Consider how these people help care for the plants by not picking the flowers. Children might acquire a feeling of responsibility for the environment through discussion of this situation.

In order to accentuate the need for protecting wild flowers and help children become better acquainted with those growing in their neighborhood, take the group for short walks with the purpose of looking at flowers rather than picking them. Develop an awareness of the need to

leave the flowers in the environment so that there may be flowers there next year. In this way, boys and girls may develop responsible behavior toward the environment.

Page 95. How Do People Care for These Animals and Plants? In answering this question, it will be necessary for boys and girls to refer to information they have gained and apply it to these new situations. This application offers children opportunities to summarize their learnings about ways people care for animals and plants. After deriving many experiential learnings, the children may find discussion of this page especially meaningful.

By reading the text at the bottom of the page, the boys and girls can check their own conclusions with those stated in the book. When answering the last question, it might be profitable for the children to organize their paintings about the care of animals and plants in a large booklet. They might make summarizing statements concerning the need to care for animals and plants which you can insert in their booklet.

Materials Needed

For use with *Science Near You*:

calcimine paints
colored chalk
newsprint, 18″ × 24″

For use with Further Experiences:

apple crate
board, 8″ wide × width of window
cotton
food for birds
log, 1′–2′ × 2″–3″
mesh bag
pictures of animals and plants
staples
string
supports for bird feeders
wire
yarn

Further Experiences

Visiting a Farm · Perhaps you and the children can visit a farm and have the experience of interviewing a farmer, seeing his cows, and finding out how he cares for them. Before going, it will be helpful for the boys and girls to decide what information about cows they want to find out from the farmer.

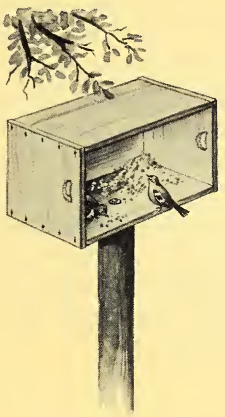
Viewing Films · The experiences of the children might be extended by looking at films, such as *Shep—The Farm Dog*, *Farm Animals*, and *Birds in Your Backyard*. (See film list for Chapter II for information about these films.) After seeing each film, ideas need to be discussed and time given for raising questions. It might be advisable to show a film more than once to help children find answers to their questions and clarify some of their concepts.

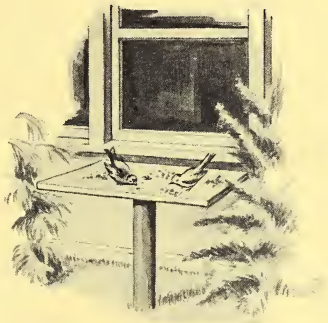
Making a Bird Feeder · Following are directions for making three simple feeders:

1. Turn an apple box on one side so that the opposite side serves as a protecting roof. Fasten the box on a support where birds can safely use it. If possible, locate the box so that the children can observe the birds in the feeder from their classroom windows.

2. Support a wide board under a window which has bushes near it so that the birds have protection.

3. Bore several holes in a small log which is 1 or 2 feet long and about 3 inches in diameter. Drive a staple into one end so that it can be suspended by wire from a support. Press suet into the holes.





The children might bring food for the birds. Suitable seeds are sunflower, squash, watermelon, pumpkin, whole or cracked corn, whole or rolled oats, wheat, barley, ground or popped corn, and grass seed. Screenings or sweepings from grain mills make inexpensive feed for birds. Suet and berries can also be placed on the feeder. Besides these foods, birds like bread crumbs, crackers, eggshells, and chopped lettuce.

Setting Up a Birdhouse · Some child might bring a birdhouse, which should be placed in partial shade in a protected location. Try to place it where the boys and girls can observe it easily from the classroom windows.

Furnishing Nesting Materials · Pieces of yarn and string several inches long may be hung on a bush or tree for birds to use as nesting materials. Tufts of cotton in a mesh bag also might be hung from a tree or bush.

Planning a Bulletin-Board Display · To show how they care for animals at home, children might organize a number of pictures under certain headings on the bulletin board. They might suggest headings, such

as "Pets Drink Water," "We Feed Our Pets," and "Pets Need Rest." The pictures they select should be of animals like those they care for at home.

Visiting a Nursery · Children might have a profitable experience by going to a plant nursery in the community. By observing the plants and interviewing the nurseryman, they can gain much information that will help them care for plants.

Evaluation

If children show considerable concern about the care of plants and animals and are able to apply their learnings to new and different situations, you may be assured that growth is taking place. They may begin to assume more responsibility for the care of animals and plants at home. They may show much enthusiasm for activities which they help plan at school. Is Richard, for example, developing more confidence as he shares some of his experiences? What attitudes toward animals and plants are Sue and Jimmy developing? Which children are becoming aware of the need for leaving wild flowers and other plants in the environment? Are they suggesting that the group take walks to see animals or plants rather than bring them into the classroom? In what ways have they shown growth in planning and carrying out their ideas? In what ways are their concepts growing along the large patterns of balance and interrelationships? Their changes in behavior may offer clues to help you in planning for further experiences.

Bibliography

For the Teacher

Blough, Glenn O., and Huggett, Albert J. *Elementary-School Science and How to Teach It*, pp. 308–332. The Dryden Press, 1951.

Craig, Gerald S. *Science for the Elementary-School Teacher*, New Edition, pp. 580–586. Ginn and Company, 1958.

For the Children

Krauss, Ruth. *The Carrot Seed.* See the Bibliography for Chapter XII.

Morgan, Alfred. *Pet Book for Boys and Girls.* See the Bibliography for Chapter II.

Smith, F. C. *The First Book of Conservation.* See the Bibliography for Chapter XIII.

Witty, Paul, and others. *Farm Animals.* See the Bibliography for Chapter II.

Films

AUTUMN ON THE FARM. (EBF) 1 reel, color. Two children observe changes during the fall months in plant and animal life as well as the different activities carried on by people.

BILLY AND NANNY—THE GOAT TWINS. (EBF) 1 reel, b/w. Illustrates traits and habits of domesticated goats on a farm.

BIRDS IN YOUR BACKYARD. See the film list for Chapter II.
THE BLUEBIRD. See the film list for Chapter II.
CARE OF PETS. See the film list for Chapter II.
FARM ANIMALS. See the film list for Chapter II.
FRISKY, THE CALF. See the film list for Chapter III.
PIG TALES. See the film list for Chapter II.
PUDGE. (IF) 1 reel, color and b/w. Produced by Children's Productions, Inc.
SEVEN LITTLE DUCKS. (Bailey) 1 reel, color and b/w. Attention is focused on way a girl cares for a family of ducks in the yard.
SHEP—THE FARM DOG. See the film list for Chapter II.
SPRING ON THE FARM. (EBF) 1 reel, color. Two children notice activities of people on a farm in the spring and also changes in plant and animal life.
SUMMER ON THE FARM. (EBF) 1 reel, color. Children see plants and animals on a farm in summer.
WINTER ON THE FARM. (EBF) 1 reel, color. Two children observe animals and plants on a farm in winter.
WONDERS OF PLANT GROWTH. See the film list for Chapter XII.

Filmstrips

ANIMAL FRIENDS. (EBF) color and b/w. These filmstrips were adapted from films of the same titles. They are: Billy and Nanny—The Goat Twins; Black Bear Twins; Common Animals of the Woods; Elephants; Gray Squirrel; Pride —The Saddle Horse; Shep—The Farm Dog; and Three Little Kittens.
GRASS AND HAY. (CurrF) color. Shows sequence of cutting, drying, and baling hay on farms.
PET STORIES. (EBF) color. The following titles are in the series: Gordon's Goldfish; Kathy's Kitten; Paul's Puppy; Peggy's Parakeet; Roger's Rabbit; and Terry's Turtle.

Appendix

Materials Needed

Use of the following materials has been suggested in *Science Near You* and this Manual. The articles are generally available within the school, from the home, or at stores in the community.

Air pump
Apple and orange crates

Ball
Ball to inflate
Balloon
Blotter
Boards
Bobby pins
Bottle
Bowls
Boxes, cardboard
Bubble pipe

Calcimine paints
Cardboard
Chalk, colored
Chicken wire
Cloth, scraps
Clothesbasket
Clothesline
Clothespins
Cocoa
Cork
Cotton
Cup

Doll clothes

Fan, electric
Flat
Flour
Flour sifter

Garden hose
Garden tools
Glass container with cover for terrarium
Glass tank with cover, 3 or 4 gallon
Glasses

Hammer
Hat, child's

Jars and covers

Key

Labels
Lemon squeezer
Log, 1′–2′ × 2″–3″

Magazines
Magnets, U, V, and horseshoe
Magnifying glass
Measuring cup
Mesh bag

Nails
Needles
Newsprint, 18″ × 24″

Pans
Paper bags
Paper towels
Paring knife
Paste
Pebbles
Pitcher

Ribbon
Rice
Rocks
Ruler

Salt
Sand
Sand pail
Sandbox
Sawdust
Scissors
Screw driver
Screws
Seed catalogues
Seeds
Shovel
Soap
Soil
Sponge
Spoons
Staples
Straw
String
Sugar

Tape, 2-inch paper
Tin cans
Tissue paper
Toy cars and trucks
Toy horn
Toy top

Washboard
Washtub
Wheel, iron
Wire
Wood, blocks and scraps
Wrapping paper, wide, heavy

Yarn

Equipment Supply Houses

Magnets may be obtained from the following sources:

CENTRAL SCIENTIFIC COMPANY, 1700 Irving Park Boulevard, Chicago, Illinois; and 79 Amherst Street, Cambridge A Station, Boston, Massachusetts; CENTRAL SCIENTIFIC COMPANY OF CALIFORNIA, 6446 Telegraph Road, Los Angeles 22,

California; Refinery Supply Company, McKinney Avenue, Houston 3, Texas; Central Scientific Company of Canada, Ltd., 146 Kendal Avenue, Toronto 4, Ontario, Canada.
Practical Aids Company, Estacada, Oregon.
Southern Scientific Company, Inc., Atlanta 3, Georgia.
W. M. Welch Scientific Company, 1515 Sedgwick Street, Chicago 10, Illinois.

Directory of Publishers

Wm. C. Brown Company, 215 West Ninth Street, Dubuque, Iowa.
Bureau of Publications, Teachers College, Columbia University, New York 27, New York.
Childrens Press, Jackson Boulevard and Racine Avenue, Chicago 7, Illinois.
Thomas Y. Crowell Company, 432 Fourth Avenue, New York 16, New York.
Doubleday & Company, Inc., 575 Madison Avenue, New York 22, New York.
The Dryden Press, 110 West 57th Street, New York 19, New York.
Follett Publishing Company, 1010 West Washington Boulevard, Chicago 7, Illinois.
Garden City Books (Doubleday & Company, Inc.), Garden City, New York.
Ginn and Company, Statler Building, Boston 17, Massachusetts.
Grosset & Dunlap, Inc., 1107 Broadway, New York 10, New York.
Harper & Brothers, 49 East 33rd Street, New York 16, New York.
D. C. Heath and Company, 285 Columbus Avenue, Boston 16, Massachusetts.
Holiday House, 8 West 13th Street, New York 11, New York.
Alfred A. Knopf, Inc., 501 Madison Avenue, New York 22, New York.
Lothrop, Lee & Shepard Company, Inc., 419 Fourth Avenue, New York 16, New York.
Melmont Publishers. Books distributed by Carl J. Leibel, Inc., 1736 South Hatcher Avenue, Puente, California.
William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, New York.
William R. Scott, Inc., 8 West 13th Street, New York 11, New York.
Charles Scribner's Sons, 597 Fifth Avenue, New York 17, New York.
Franklin Watts, Inc., 699 Madison Avenue, New York 21, New York.
Albert Whitman & Company, 560 West Lake Street, Chicago 16, Illinois.
Whittlesey House (McGraw-Hill Book Company, Inc.), 330 West 42nd Street, New York 36, New York.

Film and Filmstrip Distributors

Bailey	Bailey Films, Inc., 6509 DeLongpre Avenue, Hollywood 28, California.
Barr	Arthur Barr Productions, 1265 Bresee Avenue, Pasadena 7, California.
C–W	Churchill-Wexler Film Productions, 801 North Seward Street, Los Angeles 38, California.
Cor	Coronet Films, Coronet Building, Chicago 1, Illinois.
CurrF	Curriculum Films. Distributed by American Educational Projections Corporation, 1319 Vine Street, Philadelphia, Pennsylvania.
EBF	Encyclopaedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois; 5625 Hollywood Boulevard, Hollywood 28, California; 7250 MacArthur Boulevard, Oakland, California; 277 Pharr Road, N.E., Atlanta,

	Georgia; 161 Massachusetts Avenue, Boston 15, Massachusetts; 4902 Argyle Street, Dearborn, Michigan; 7421 Park Avenue, Minneapolis 23, Minnesota; 202 East 44th Street, New York 17, New York; 463 West Main Street, Kent, Ohio; 2129 Northeast Broadway, Portland, Oregon; 1414 Dragon Street, Dallas, Texas.
Frith	Frith Films, 1816 North Highland, Hollywood 28, California.
Heidenkamp	Heidenkamp Nature Pictures, 538 Glen Arden Drive, Pittsburgh 8, Pennsylvania.
Holst	Kenneth L. Holst, 1399 North Lake Avenue, Pasadena 6, California.
IF	Instructional Films, Inc. See addresses listed under Encyclopaedia Britannica Films, Inc.
JH	The Jam Handy Organization, 2821 East Grand Boulevard, Detroit 11, Michigan.
McGraw-Hill	McGraw-Hill Book Company, Inc., Text-Film Department, 330 West 42nd Street, New York 36, New York.
SVE	Society for Visual Education, Inc., 1345 West Diversey Parkway, Chicago 14, Illinois.
UW	United World Films, Inc., 7356 Melrose Avenue, Hollywood 46, California; 605 West Washington Boulevard, Chicago 6, Illinois; 1445 Park Avenue, New York 29, New York.
YAF	Young America Films, Inc., 18 East 41st Street, New York 17, New York.

National Film Rental Agencies

Association Films, Inc., 347 Madison Avenue, New York 17, New York; 799 Stevenson Street, San Francisco, California; 561 Hillgrove Avenue, La Grange, Illinois; Broad at Elm, Ridgefield, New Jersey; 1108 Jackson Street, Dallas 2, Texas.

Brandon Films, Inc., 200 West 57th Street, New York 19, New York.

The Bray Studios, Inc., 729 Seventh Avenue, New York 19, New York.

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Instructional Films, Inc. See addresses for Encyclopaedia Britannica Films, Inc.

International Film Bureau, Inc., 57 East Jackson Boulevard, Chicago 4, Illinois.

Nu-Art Films, Inc., 112 West 48th Street, New York 19, New York.

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